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A STATISTICAL ANALYSIS OF THE DETERRENCE EFFECTS OF THE MILITARY SERVICES' DRUG TESTING POLICIES

by

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March 1998

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This thesis examines the magnitude of the deterrence effect associated with the military services' drug testing policies. Using data from the 1995 Department of Defense Survey of Health Related Behaviors Among Military Personnel and the 1995 National Household Survey on Drug Abuse, illicit drug use rates are modeled as a function of pertinent demographic characteristics. The natural variation in drug testing policies is exploited to estimate the deterrence effects of such programs. The first analysis relies on the variation in drug testing policies among the military services. The second analysis relies on the difference in the extent of drug testing between the military and civilian sectors. Non-linear maximum likelihood (logit) techniques are used to estimate the deterrence effects. The results indicate a significant deterrence effect associated with the frequency and intensity of the services' drug testing program both in comparison to each other and in comparison to the civilian sector. However, omission of price and income controls may have caused overestimation of the true deterrence value. Further study using more sophisticated techniques is recommended to clarify this potential bias.

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A STATISTICAL ANALYSIS OF THE DETERRENCE EFFECTS OF THE MILITARY SERVICES' DRUG TESTING POLICIES

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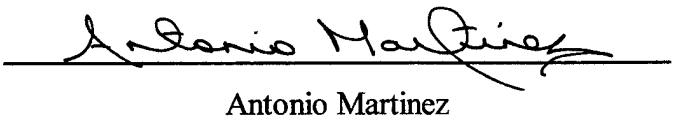
Author: 

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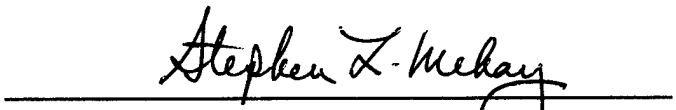
Approved by: 

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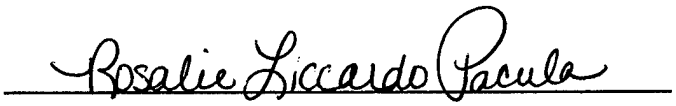

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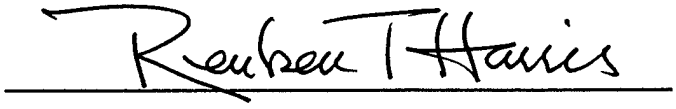

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ABSTRACT

This thesis examines the magnitude of the deterrence effect associated with the military services' drug testing policies. Using data from the 1995 Department of Defense Survey of Health Related Behaviors Among Military Personnel and the 1995 National Household Survey on Drug Abuse, illicit drug use rates are modeled as a function of pertinent demographic characteristics.

The natural variation in drug testing policies is exploited to estimate the deterrence effects of such programs. The first analysis relies on the variation in drug testing policies among the military services. The second analysis relies on the difference in the extent of drug testing between the military and civilian sectors. Non-linear maximum likelihood (logit) techniques are used to estimate the deterrence effects.

The results indicate a significant deterrence effect associated with the frequency and intensity of the services' drug testing program both in comparison to each other and in comparison to the civilian sector. However, omission of price and income controls may have caused overestimation of the true deterrence value. Further study using more sophisticated techniques is recommended to clarify this potential bias.

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I. INTRODUCTION

A. ENVIRONMENT

Drug testing is, without question, a volatile issue that sparks much emotional debate and controversy. However, the negative physical and psychological effects of illicit drug use and abuse are well studied and validated in numerous publications [Ref. 1]. Given the importance and inherently dangerous nature of the military's mission, the Department of Defense (DoD) expends considerable time and resources implementing its current drug testing policy. Two main purposes of the testing policy are to detect and, by extension, deter illicit drug use among its members.

A recent trend that has alarmed the DoD concerns the findings of the 1995 National Household Survey on Drug Abuse which concluded that illicit drug use among civilian teenagers was rising dramatically. The monthly rate of illicit drug use increased from 5.3 percent in 1992 to 10.9 percent in 1995 for teenagers ages 12 through 17 years old [Ref. 2]. This trend among the civilian youth population influences the DoD because most military recruits are drawn from this demographic segment of the civilian market. The DoD is, in a real sense, a microcosm of the civilian society from which it recruits. Illicit drug use and abuse increases the risk of accidental injuries and death, not only among those who abuse drugs, but also among their co-workers [Ref. 3]. As a result of these dangers, the DoD has implemented an aggressive and comprehensive drug

testing policy to confront drug abuse [Ref. 4]. Armed with the initial DoD guidance, each service implemented their own illicit drug testing programs, which differ substantially in testing intensity and frequency.

Given the current congressional climate of military fiscal restraint, information from this study will benefit the DoD by determining if it is most efficiently utilizing its drug testing program funds. Furthermore, the predictions can be used to determine whether enlistment standards should be modified to meet the changing climate with respect to the quality of prospective military applicants (as measured by illicit drug usage). Also, information from this study can be used to determine whether the screening methods used for determining who qualifies for military service are appropriate or, alternatively, if they should be modified.

B. OBJECTIVES

This thesis will examine the magnitude of the deterrence effects associated with the drug testing programs conducted by the U.S. military. Additionally, this thesis will examine if there are any differences in deterrence effects across the service branches as a result of each service's distinct drug testing policies.

C. THE RESEARCH QUESTION

The primary question that this research will answer is:

- What is the impact of the U.S. military's drug testing policies in deterring illicit drug use by military personnel?

Secondary questions include:

- What does prior research on the subject indicate?
- What are the individual service drug testing procedures and policies?
- What is the estimated deterrence effect of each service policy?
- Is there any correlation between the estimated deterrence effect and the respective military services' drug testing policy?

D. SCOPE

Several prior studies have been performed hypothesizing a link between the frequency of drug testing and deterrence of use. Given that each service has a unique drug testing program, this research will either confirm or refute the prior studies by assessing the strength of the deterrence effect of the military's overall program by comparing military and civilian drug use.

E. ORGANIZATION OF STUDY

Chapter II presents a review of the relevant studies that impact this research in terms of theory, demographic models, and results. Chapter III describes the history of the DoD's drug testing program and that of the individual

services as well. Chapter IV provides information regarding the surveys used in this research, the 1995 National Household Survey on Drug Abuse and 1995 Department of Defense Survey of Health Related Behaviors Among Military Personnel. Chapter V discusses in detail the research methodology and explains why the techniques used were chosen. Chapter VI specifies the multivariate models pertaining to the deterrence effect of drug testing. The estimated results of the multivariate models and their policy implications are also discussed in this chapter. Finally, Chapter VII summarizes the conclusions of the analysis, addresses research limitations, and presents recommendations for further research.

II. THEORETICAL FRAMEWORK AND LITERATURE REVIEW

A. THEORY

Although many studies have been published highlighting the growing problem of illicit drug use, this thesis primarily concerns itself with measuring the effects of programs designed to stop its use. Specifically, this study will determine the deterrence effect of the U.S. military services' drug testing policies. Within this context, each service drug testing program must devise a way to deter the greatest number of potential or actual drug users within economic constraints. In order to devise such a plan, the factors that influence illicit drug use or its abstinence must be taken into consideration. Since each service has its own unique drug testing policy of varying scope and intensity, this facilitates examining the deterrence effectiveness based on known factors. It is the purpose of the following literature review to introduce these factors that affect illicit drug use and abstinence. Additionally, the literature will present justification for the methodology employed in performing this research.

B. LITERATURE REVIEW

1. A Conceptual Model for Determining an Optimal Drug Testing Program

Published in January 1996, Jules I. Borack and Stephen L. Mehay conducted research on drug testing for the Navy Personnel Research and Development Center (NPRDC), San

Diego, California. The objective of their efforts was to develop a conceptual model for determining an optimal drug testing strategy [Ref. 5]. The analysis was predicated on the hypothesis that a series of earlier studies, based on Markov chain models, were of limited value in helping the Navy detect illicit drug users. "While these models are helpful in analyzing the relationships between random drug testing procedures and the probability of detection within specified periods of time, they failed to evaluate the economic efficiency of alternative drug testing policies" [Ref. 5]. Additionally, Borack and Mehay argued that the Markov chain models did not address the deterrence effect, a key factor of the drug testing equation. This deficiency led to testing rates and strategies that were based primarily on general impressions rather than scientific fact. As such, Borack and Mehay theorized that there were more effective scientific methods for determining the Navy's optimal drug testing scheme.

As previously established, the prevalence rate of illicit drug use in the civilian sector greatly affects the military services. Borack and Mehay point out that while the military recruits from the civilian population, the prospective applicants can be segmented by age, gender, race, geographic location, socio-economic status, and other factors related to the likelihood of using illicit drugs [Ref. 5]. These demographic characteristics assist not only in determining the inclination for drug use, but also in providing an expected proportion of drug users. As will be seen, Borack and Mehay utilized this information to their advantage in constructing their conceptual model.

Borack and Mehay introduced the term "drug day" to define the cost of drug abuse. A drug day is defined as the probability that on any given day during a specific period of time, a person could test positive for illicit drug use if subjected to drug testing. For example, if during a given month a person has a 20 percent probability of testing positive on any given day, then he or she will contribute six (.2 x 30) drug days to the overall total. This drug day concept is tied to the Navy's drug abuse policy which, in general terms, states that drug abuse is incompatible with Naval Service. Each drug day translates into higher costs for the Navy due to the adverse and prohibitively high expenses associated with drug abuse (such as increased crime, productivity loss, and adverse health concerns). Given this, the Navy's policy objective is aimed directly at minimizing or altogether eliminating drug days through deterrence and in the process, reducing the costs associated with drug use.

Borack and Mehay highlight the fact that while the baseline cost of drug abuse may be the same for any given day, it will vary by demographic group. An exaggerated comparison of this difference would be the cost to the Navy of Admiral Smith testing positive for illicit drug use on the same day that Seaman Apprentice Jones tested positive. In this example, it is clear that the cost imposed on the Navy is not equal in both cases. However, once a specific demographic baseline cost value has been established, it can be applied to all members of that group to determine the total cost of illicit drug use.

In estimating the deterrence effect, Borack and Mehay measured the degree to which the rate of testing influences the conditional probability of a positive urinalysis test. If at a 10 percent and 15 percent monthly test rate, five percent and two percent of the population test positive, respectively, the three percent drop in the detection rate translates into a 60 percent deterrence rate.

The detection effect of a particular drug testing strategy can be measured by the probability of detecting drug users with specific patterns of drug usage [Ref. 5]. Many factors affect this detection probability including drug use pattern, drug use frequency, drug potency, and test sensitivity level. The underlying premise is that if an individual suspects that his or her illicit drug use will be detected, then their propensity to use illicit drugs will diminish as a result of their beliefs. Of particular note is that drug users can also effect the detection rate based on their actions. "Drug users may also be gaming or non-gaming, that is, they may or may not vary their drug intake depending upon their perceived probability of detection" [Ref. 5]. Borack and Mehay account for this distinction by using methods, developed in prior research by Borack [Ref. 6], to predict the probability of detecting gaming and non-gaming users.

Borack and Mehay combined all their research to construct a model that was comprised of the following categories: (1) drug days; (2) cost of drug abuse; (3) deterrence effect; (4) detection effect; and as cited earlier, (5) personal characteristics that affect a person's likelihood to use illicit drugs. They used their

model to compare illicit drug use in the Navy to a demographically comparable sample from the civilian population. Figure 1 is a graphical representation of Borack and Mehay's conceptual model.

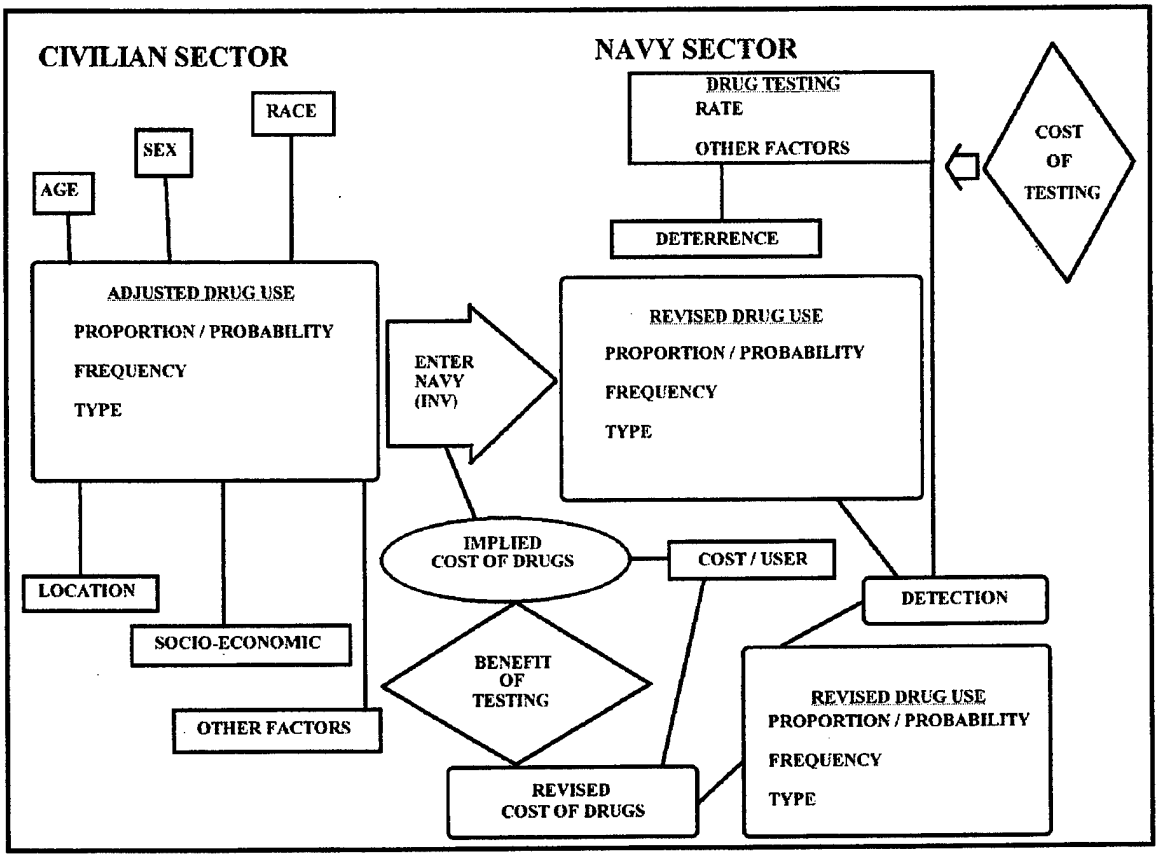

Figure 1. Conceptual Model for Determining an Optimal Drug Testing Program [Ref. 7].

In order to calculate the deterrence effect associated with drug testing, Borack and Mehay required a baseline usage rate in the absence of drug testing. Using data from the 1991 National Household Survey on Drug Abuse, they calculated a civilian baseline rate of illicit drug use in the absence of testing. This baseline estimate was then

applied to the 1994 Navy population, standardized by demographic characteristics. Their calculations indicated that 9.96 percent of Navy personnel would use drugs at least once monthly if there were no threat of drug testing. Furthermore, using their model, Borack and Mehay calculated the deterrence rate of testing. They did so by first calculating drug use rates in the absence of testing and then for different drug testing rates. These calculations were performed for five non-consecutive years (1980, 1982, 1985, 1988, and 1992). A logistic regression function was then fitted to explain the percentage difference between the estimated proportion of personnel who would use illicit drugs in the absence of testing, and the proportion of personnel who would use illicit drugs. This percentage difference variable was regressed on the testing rate for each period.

Regression results indicate that the illicit drug usage rate for Navy personnel was 60 percent lower than it would have been in the absence of testing. Since the baseline usage rate in the absence of testing was calculated at 9.96 percent, then approximately six percent of the Navy population would be deterred from using illicit drugs. Borack and Mehay assert that this calculated decrease is directly attributable to the deterrence effect associated with the Navy's drug testing policy.

Borack and Mehay point out that the optimal implementation of the Navy's drug testing program is where the marginal costs of increased testing equals the marginal benefits (costs avoided) associated with decreased drug use. The Navy's current testing program has two elements

assumed constant here; (1) adoption of a drug testing program in lieu of education or prevention programs; and (2) immediate discharge from the service for testing positive (zero tolerance).

In order to ascertain the monetary benefits associated with deterred drug use, Borack and Mehay relied on a conventional labor economics principle which states that workers are paid based on the value of their marginal productivity [Ref. 8].

> Assuming job characteristics and human capital endowments are equal, any differences in pay between the two individuals will be determined in large part by differences in their productivity. Therefore, any observed differences in pay for otherwise equal workers, who differ only with respect to their drug use, would provide a measure of how their employers and the labor market as a whole valued the productivity difference between them and their non-drug using counterparts. [Ref. 5]

Since Navy workers do not produce measurable units of physical output but instead are valued in intangible terms such as readiness and national defense (i.e., marginal product), Borack and Mehay use regular military compensation, pay and benefits, as a proxy for perceived marginal product.

Because it is extremely difficult to observe differences in productivity due to drug use outside of a controlled experiment, Borack and Mehay present the results of several civilian studies pertaining to the pay differentials associated with drug and alcohol use. In essence, the pay differentials measure how much drug use

degrades productivity and thus, earnings [Ref. 5]. Borack and Mehay apply to their analysis the high and low differential estimates of one such civilian study, Mullahy and Sindelar [Ref. 9], as a measure of the productivity difference. Borack and Mehay refer to these differentials as the "degradation factor" because, in their estimation, illicit drug use is viewed as a tax on output that limits full productivity. Borack and Mehay indicate that in order to determine the differences in productivity between comparable illicit drug users and those that abstain, the degradation factor must be multiplied by the regular military compensation factor introduced earlier.

Using the six percent deterrence factor calculated previously, Borack and Mehay estimate that the annual benefits from the drug testing deterrence effect range from a low of $176.3 million to a high of $213 million. In determining the costs avoided, they accounted for the costs associated with the drug use patterns of the personnel recruited to replace those discharged for illicit drug use.

A potential weakness of the Borack and Mehay study is that the degradation factor may tend to underestimate the effect of drug use in the Navy. This is due to the fact that the sample was based on the civilian population, and Navy personnel are more inclined to work in extremely safety conscious jobs, or in a teamwork environment that is critical to mission accomplishment. As such, the costs and externalities associated with military drug abuse may have a larger effect on the Navy's costs than in a comparable civilian industry.

Despite this possible limitation, in concluding their research, Borack and Mehay recommend "…that the conceptual model form the basis of a computerized drug policy analysis system for use by drug policy managers to determine optimal drug testing strategies" [Ref. 5]. Furthermore, they recommend that additional parameters such as a wider variety of drug testing strategies be incorporated into their model.

Before proceeding, it would be prudent at this juncture to highlight another possible shortcoming of the Borack and Mehay study that was not specifically addressed in their publication. Recall that Borack and Mehay determined the percentage difference of drug usage rates with and without the threat of testing for five nonconsecutive years of data. However, their calculations produced only five data points upon which to construct their logistic regression function. In essence, Borack and Mehay estimated the deterrence effect of the Navy's drug testing program using only five time series observations.

While it is possible that their time series data do, in fact, accurately represent the deterrence effect of the Navy's testing program, it is worthwhile to attempt to replicate their results using alternative data and methodologies. Such replication attempts are necessary before we can be confident of the existence and size of the deterrence effect and thus, the true benefits of testing programs. The goal of this thesis is to provide one such replication.

2. A Technique for Estimating the Impact of Improvements in Drug Testing Sensitivity on Detection and Deterrence of Illicit Drug Use by Navy Personnel

Published in May 1997, Jules I. Borack conducted further research regarding improved drug testing estimation techniques for NPRDC, San Diego, California. The objective of his research was, "…to (1) extend the model developed in Borack and Mehay (1996) to link improvements in urinalysis test sensitivity to changes in deterrence and detection of Navy illicit drug users and (2) estimate the deterrence and detection effects of tests of alternate sensitivity" [Ref. 7].

Borack's hypothesis was rooted in the assumption that the deterrence effect of drug testing was a function of the probability of illicit drug use detection. "Simply put, the higher the probability of detection, the greater is the deterrence effect" [Ref. 7]. Borack defined drug testing sensitivity as the probability that an individual would test positive for drug use given that he or she used illicit drugs. In the Borack and Mehay study cited previously, it was assumed that drug detection would occur with 100 percent certainty if a drug test were administered within two days of drug use. After this time period, detection would not occur. Borack used the results of the Borack and Mehay study as a baseline for testing the deterrence effects for two alternative test sensitivities.

Borack desired to determine what would be the deterrence rate if the test sensitivity rate was either increased or decreased (in the Borack and Mehay study, a 20 percent monthly test rate was used). Specifically, what

would be the deterrence rate if illicit drug use could be detected with 100 percent certainty four days after drug use; and what would be the deterrence rate if illicit drug use could be detected with only 50 percent certainty within two days after drug use? Utilizing the same methodology and conceptual model as in the Borack and Mehay analysis (see figure 1), Borack estimated the deterrence effect associated with the two alternative test sensitivities.

The results determined that at the increased drug testing sensitivity level, the same baseline deterrence effect could be achieved at a 15 percent monthly test rate versus 20 percent. Alternatively, at the decreased drug testing sensitivity, a 40 percent testing rate would be required to achieve the baseline deterrence effect. Based on these results, Borack surmised that improvements in drug testing sensitivity would have a significant impact upon testing rates for specific deterrence and detection levels and on the costs of testing. In concluding his analysis, Borack highlights the fact that there are profound tradeoff between testing sensitivity and testing rate and that improvements in test sensitivity can greatly impact the cost and effectiveness of a drug testing program.

Since Borack used the same methodology as in the Borack and Mehay study cited previously, the possible shortcoming mentioned with respect to construction of the logistic function is also applicable. As already stated, a goal of this thesis is to replicate the finding of the above studies with regard to the deterrence effects of the military services' drug testing policies. However, the differences among the individual service's drug testing

programs must be evaluated before undertaking the statistical analysis. These differences will provide one of the tests of the deterrence effects.

III. BACKGROUND

A. DEPARTMENT OF DEFENSE DRUG TESTING POLICY

In 1967, a DoD task force was convened to investigate increased illicit drug use within the military services [Ref. 4]. At the time, President Nixon felt strongly that illicit drug users could be initially identified through drug testing and rehabilitation [Ref. 3]. By 1970, the task force findings led to formal procedure formulation and in the summer of 1971, marked the birth of DoD's urinalysis drug testing program. The original intent of the new policy was to identify illicit drug users, rehabilitate them, and return them to full duty status [Ref. 4]. During this period, the DoD's urinalysis testing program was not envisioned as a tool for disciplinary or punitive actions. The expectation was that in the absence of negative consequences, illicit drug users would be more inclined to seek assistance and rehabilitation [Ref. 10]. However, this result was not the case.

By 1974, researchers at the Human Resources Research Organization (HumRRO) determined that there were considerable differences between the number of surveyed military personnel who anonymously said they used drugs and the number indicated by the urinalysis testing program. Furthermore, HumRRO's research concluded that DOD's drug testing program was not a deterrent to the people who desired to use drugs [Ref. 11]. That same year, in response to the study, DoD changed its approach and started

using the results of drug tests as the basis for Uniform Code of Military Justice (UCMJ) actions. However, a Military Court of Appeals decided later that same year that the urinalysis program could not be used for disciplinary or administrative action. Their decision, in effect, virtually nullified the deterrence effect of the program, because detected personnel could only be referred to a rehabilitation center. For the following six years, the drug urinalysis program was utilized solely to determine individual need for drug rehabilitation. Then in 1980, as suddenly as the Military Court of Appeals stopped the punitive drug testing policy, it reversed their 1974 decision. The court's reversal removed the sole obstacle blocking the DoD's desire to implement a drug testing program which could be used as both a deterrent and evidence-gathering device [Ref. 12]. As a result of this new attitude and legal position concerning drug testing, DOD issued a new directive updating its drug testing policy.

In August 1980, DOD published Directive 1010.4 (DoDD 1010.4). The overall goal of this directive was to free DoD from the ill effects of illicit drug use by defining the alcohol and drug abuse policy standards military members were obligated to adopt [Ref. 13]. Within the specific scope of this thesis, DoDD 1014.4 was published to address the following concerns:

- Assess the alcohol and drug abuse...influencing DOD.

- Not induct persons into the military services who are alcohol or drug dependent.

- Deter and detect alcohol and drug abuse within the armed forces….

- Provide continuing education and training…to alleviate problems associated with alcohol and drug abuse.

- Treat or counsel alcohol and drug abusers and rehabilitate the maximum feasible number of abusers. [Ref. 13]

DoDD 1010.4 also required each service secretary to enact and operate urinalysis drug testing programs for their respective services. In order to guide the secretaries in accomplishing this requirement, a second directive, DoDD 1010.1, was issued in 1980.

DoDD 1010.1 outlined the drug testing guidelines the services were required to use in crafting their respective drug testing programs. Specifically, DoD's intent in issuing DoDD 1010.1 was the achievement of two primary drug detection goals. The first goal was to preserve the health of its military members. DoD proposed accomplishing this by providing counseling, medical treatment, or rehabilitation to identified alcohol and drug abusers. The second goal was to provide commanders with a tool that would assist them in evaluating the good order and discipline, security, and military fitness of their commands. The underlying principle here is that commanders, aided by the drug testing results, could take the appropriate action necessary to restore unit integrity based on their assessments. [Ref. 14]

Additionally, DoDD 1010.1 listed guidelines and limitations in using urinalysis test results. It clearly stated that drug testing results could be used, with certain restrictions, in punitive or separation proceedings. In publishing the order, DoD laid the foundation upon which the individual services could build their respective random urinalysis testing programs [Ref. 14]. Armed with the new DOD guidance, each of the services issued its own policy concerning urinalysis drug testing.

B. U.S. ARMY DRUG TESTING POLICY

The U.S. Army's drug testing program is governed by Army Regulation 600-85. Specified as the *Alcohol and Drug Abuse Prevention and Control Program*, this directive was first issued in December 1981 and substantially revised and re-issued in October 1988. As stated in the revision, the Army's general policy is that alcohol and drug abuse is, "...incompatible with military service" [Ref. 15]. In support of its overall policy, the Army formulated four specific objectives into its biochemical drug testing program. They were:

- Early identification of alcohol and drug abuse.
- Deterrence of drug abuse.
- Monitoring of rehabilitation progress for those who require testing as part of their rehabilitation plan.

- Development of data on the prevalence of alcohol and drug abuse within the Army. [Ref. 15]

Army Regulation 600-85 empowered Army unit commanders by authorizing them the freedom to set their own drug testing rates for members of their command. "Urine and alcohol tests will be conducted at the unit or elsewhere as the commander directs" [Ref. 15]. Despite the impressive latitude afforded Army commanders, this independent responsibility was tempered with limitations on testing frequency. Commanders were authorized to test members of their commands only if they had a reasonable suspicion that an individual was using illicit drugs, as a component of a search and seizure action, as an element of a unit inspection (unit drug testing sweep), or for valid medical reasons [Ref. 15].

In October 1995, the Department of the Army issued a revision to Army Regulation 600-85. Along with reiterating the Army's policy that drug abuse would not be tolerated, the change updated the requisite actions that commanders were obligated to take against identified illegal drug abusers. Specifically, the revision mandated that, "any soldier involved with the illicit trafficking, distribution, or selling of drugs will be processed for administrative separation for misconduct and, as appropriate, for disciplinary action under the UCMJ" [Ref. 16]. The revision also stated that, regardless of rank, any soldier with three or more years of military service, who was identified as a drug abuser, would be considered for disciplinary action under the UCMJ as well as processed

for separation. The one exception to this separation-processing standard was a soldier with less than three years of active service at the time they were initially identified as an illicit drug abuser. In this case, the soldier would be subject to disciplinary action but not processed for separation until a second incident of illicit drug abuse. In effect, the Army drug testing program granted soldiers with less than three years service a second chance. In addition, the separation-processing mandate that applied to soldiers with three or more years on active duty did not necessarily guarantee their dismissal from Army active duty. [Ref. 16]

C. DEPARTMENT OF THE NAVY DRUG TESTING POLICY

In January 1984, the Department of the Navy (DoN) issued Office of the Secretary of the Navy Instruction 5300.28A (SECNAVINST 5300.28A) [Ref. 17]. In accordance with the DoD mandates previously cited, this publication promulgated the policies and regulations regarding alcohol and drug abuse within DoN. Designated *Alcohol and Drug Abuse Prevention and Control*, SECNAVINST 5300.28A required that the Chief of Naval Operations and the Commandant of the Marine Corps establish and conduct alcohol and drug abuse prevention programs for their respective services. Furthermore, the instruction outlined that in forging their respective programs specific attention was to be given to the areas of detection and deterrence; treatment and rehabilitation; education and training; and, enforcement and discipline [Ref. 12].

With regards to detection and deterrence, SECNAVINST 5300.28A mandated that a comprehensive random urinalysis-testing program be enacted with the purpose of disclosing drug abuse among military members, regardless of rank. Subject to some limitations, the instruction allowed for the use of positive test results as the basis for appropriate disciplinary action; separation proceedings; and referrals of military members for treatment or rehabilitation programs. [Ref. 17]

1. U.S. Navy Drug Testing Policy

In September 1980, DoN issued Office of the Chief of Naval Operations Instruction 5350.4 (OPNAVINST 5350.4). Titled *Substance Abuse Prevention and Control*, this document published the drug testing policy for members of the U.S. Navy. As stated in OPNAVINST 5350.4, the Navy's general policy toward substance abuse is zero tolerance. Simply put, legal drug abuse or illicit drug use would not be tolerated. "Zero tolerance recognizes that drug and alcohol use is incompatible with the maintenance of high standards of performance, military discipline, and readiness and is destructive of Navy efforts to instill pride and promote professionalism" [Ref. 18]. In support of their general policy, the program required commanders to test between 10 and 20 percent of their commands on a monthly basis. Enhanced detection and deterrence at all levels are major elements in the Navy's drug testing program [Ref. 12]. The Navy's main purpose, with regard to drug testing, was to:

> Detect and deter abuse at a level that ensures the continued visibility of command drug abuse detection efforts, lessens the need to conduct broad scope random samples or unit sweeps, and does not impact negatively on Naval Regional Medical Center drug screening labs or other testing assets…. [Ref. 18]

Despite the strict-sounding nature, the Navy's zero tolerance drug abuse policy was not applied evenly to all personnel but was differentiated by rank [Ref. 19]. Naval officers and chief petty officers (senior enlisted) were the only personnel automatically processed for administrative discharges after punitive proceedings were completed. Rehabilitation for these offenders was accessible through the Veterans Administration upon discharge. Persons in the junior pay grades (Seaman through First Class Petty Officer) were to be screened and offered rehabilitation if their problems were deemed treatable. This treatment would be offered subsequent to completion of punitive actions. After punitive and rehabilitative proceedings were completed, the individual could be returned to duty if deemed worthy for retention [Ref. 18]. This double standard application of the zero tolerance drug abuse policy continued until 1990.

In September 1990 a drug testing policy revision, OPNAVINST 5350.4B, was issued. This new instruction applied the policy of "zero tolerance" to the entire Navy, regardless of rank. If illegal drugs were detected as a result of a random drug urinalysis, the individual would be processed for separation following punitive proceedings. However, processing individuals for administrative

separation would still not necessarily result in discharge if they were deemed worthy for retention. In addition to the shift in policy, OPNAVINST 5350.4B augmented the purpose of the Navy's drug testing program. There are now four goals of the Navy's substance abuse policy: (1) it establishes a means for assessment of command readiness; (2) it deters drug use; (3) it is a tool for monitoring personnel in rehabilitation programs; and (4) it establishes a historical record that can be utilized to track the demographic characteristics of Navy drug use. [Ref. 20]

OPNAVINST 5350.4B mandated that commanding officers use the urinalysis-testing program with no less than a 10 percent and no more than a 20 percent monthly command test rate unless given special authorization. However, as with the U.S. Army, there were limitations on the frequency of use. Navy Commanding Officers were authorized to test their commands only if they had a reasonable suspicion that an individual was using illicit drugs, as a component of a search and seizure action, as an element of a unit inspection (unit drug testing sweep), or for valid medical reasons [Ref. 20]. As of January 1996, commanding officers are now authorized to test up to 30 percent of their command monthly without special authorization [Ref. 21]. This latest change allowed commanding officers some flexibility in setting command testing rates, while ensuring that the Navy retained some consistency throughout the fleet by setting minimum and maximum testing parameters.

2. U.S. Marine Corps Drug Testing Policy

In December 1996, the U.S. Marine Corps substantially revised and reissued Marine Corps Order P5300.12A (MCO P5300.12A). This publication, titled *The Marine Corps Substance Abuse Program*, disclosed the policies, procedures, and standards of the altered program, and established responsibility for its execution. The Marine Corps' general policy toward illegal drug and chemical abuse is:

> The Marine Corps will not tolerate the possession, use, sale, or distribution of illegal drugs and believes a drug free environment is essential to mission accomplishment. Accordingly, all Marines, regardless of pay grade, determined as having or possessed illegal drugs will be processed for administrative separation for misconduct, by reason of drug abuse…. [Ref. 22]

The purpose of the Marine Corps urinalysis program is similar to that of Army and Navy with one exception. While its purpose included assessment of command readiness, deterrence, rehabilitation monitoring, and statistical data tracking, the substance abuse policy was also established to eliminate illegal drug use within the Marine Corps [Ref. 22].

The Marine Corps Substance Abuse Program is divided into two major phases, proactive and reactive. The proactive phase consists of measures taken by commanding officers to preclude substance abuse. These actions primarily address the areas of prevention, education, and deterrence. The reactive phase occurs after an event or

incident of substance abuse has taken place. Inclusive in this phase is identification, early intervention, treatment and rehabilitation, discipline (if appropriate), and reinstatement to full duty or separation. [Ref 22]

With regard to proactive deterrence, MCO P5300.12A mandates that all Marine Commanders conduct unit urinalysis testing programs in accordance with DoDD 1010.1. Similarly, Marine Corps Commanders are also bound by the test rates established in SECNAVINST 5300 series publications. However, the same limitations on frequency of testing that apply to the Navy and Army applies to the Marine Corps as well.

During the reactive phase, commanding officers have broad discretion in determining the consequences imposed on drug use policy offenders based on their assessment of the infraction. Despite the mandatory separation proceedings commander must initiate, Marines identified as illicit drug users can be retained in the Marine Corps if their commander determines that there is potential for future military service. Among other issues, commanding officers consider the severity of the specific incident, the Marines' attitude towards treatment and rehabilitation, and the investment the Marine Corps has made in the Marine to determine potential for future service. [Ref. 22]

It should be noted that the Marine Corps and Navy policies on substance abuse mirror each other in myriad ways. Among other issues, both essentially have the same zero tolerance stance on illicit drug use and legal drug abuse. Additionally, both policies require adherence to mandatory separation proceedings for violators of their

respective drug abuse policies. However, regardless of program, mandatory separation proceedings do not necessarily equate into mandatory separations for Navy and Marine Corps drug use violators.

D. U.S. AIR FORCE DRUG TESTING POLICY

As stated in Air Force Instruction (AFI) 44-121, issued in January 1998, the U.S. Air Force's general policy regarding substance abuse is that it does not tolerate the illegal or improper use of drugs [Ref. 23]. AFI 44-121 categorizes illicit drug use as a serious breach of discipline that is incompatible with Air Force service and automatically places the offender's continued service in jeopardy. Additionally, the publication states that such use can lead to criminal prosecution resulting in punitive charges or administrative actions, to include separation or discharge under other than honorable conditions [Ref. 23].

In devising their drug abuse testing policy, the Air Force set specific goals it wanted its program to achieve. These goals are:

- Deterrence of illicit drug use.
- Identification of personnel who need treatment or rehabilitation.
- Collect data on the prevalence of drug abuse.
- Provide rehabilitation support through monitoring.

- Develop evidence in support of administrative actions, rehabilitative services, separations, and UCMJ actions.

- Provide a tool for commander to maintain the morale, welfare, and health of their commands. [Ref. 24]

The enforcement of the Air Force's drug abuse policy rests with local commands, where each commander is tasked with the responsibility of issuing their own drug abuse policy memorandum. These memoranda support the hard line stance taken by the Air Force as a whole, which, as previously mentioned, is "no tolerance." Each command memorandum ensures that Air Force personnel realize that frequent and random drug testing will be employed to deter abuse and enforce the zero tolerance policy. Furthermore, commanders are empowered to order spot testing anytime they feel there is reasonable suspicion of drug or alcohol abuse. [Ref. 24, 25 and 26]

In an effort to stop or reduce drug abuse or potential drug use, the Air Force also developed a well-planned and executed training and education strategy. Substance abuse prevention strategies were comprehensively structured to reduce individual and organizational risk factors while increasing resiliency factors in high-risk populations [Ref. 23]. Education programs were geared toward increasing organizational and individual awareness of substance abuse issues, trends, and threat to mission readiness. Education also ensured that health care providers, commanders, and senior enlisted supervisors understood the impact of substance abuse on mission

completion, understood how to identify the warning signs of substance abuse, and understood the referral process. To underscore the continued need for education on the subject, the policy directed that drug abuse education and training occur quarterly and immediately following any change of duty station [Ref. 23].

Despite the various courses of action Air Force commanders had at their disposal to deter drug abuse, the options they were given after a confirmed drug detection were limited. Commanding officers are required to establish programs to prevent drug abuse, identify drug abusers, and provide transitional counseling while pending separation [Ref. 27]. Specifically, if a commander obtained a confirmed positive drug test result, he or she was obligated to process the offender for administrative actions. Administrative actions included, if applicable, "…removal from flying status or sensitive duties; withdrawal of security access; letter of reprimand; separation from service; and other personnel actions such as denial of reenlistment or removal from duties involving firearms" [Ref. 28]. This policy left the commander virtually no option to retain the service member once a confirmed positive test result was obtained. As a result of this strict stance, 95 percent of all confirmed positive drug tests ends in the separation of the member from the Air Force, regardless of rank, length of service, or investment [Ref 29]. As one study characterized the Air Force policy, "Generally, Air Force commanders administratively discharge all identified drug abusers" [Ref. 30].

E. POLICY COMPARISON

Recall that the focus of this thesis concerns the estimation of the deterrence effect based on differences in drug testing policies among the services. An individual comparison of service policies shows that three of the four programs (Army, Navy, and Marine Corps) have very similar zero-tolerance policies for combating illicit drug use within their respective services. Some differences among the three service policies arise in testing procedures and policy execution. The main difference is that the Army allows soldiers with less than three years service a reprieve from separation proceedings for their first policy infraction; an option that the Navy and Marine Corps do not offer. Thus, enforcement in the Naval Services appears to be stricter than in the Army. However, the underlying principle concept in all three programs is the same. While punitive proceedings are imposed on illicit drug users, their drug use does not necessarily lead to separation from their respective services.

The Air Force's zero tolerance illicit drug use policy also requires that all members testing positive begin separation proceedings. However, as opposed to the other services, it is almost certain that a member will be separated from the Air Force after a confirmed positive test result. Exceptions to this standard occur when the intent of the offending member cannot be established. For example, was it dosage amount, ignorance, or purposeful intent that caused an airman's wrongful use of prescription drugs? [Ref. 29]

If one were to rank the services' policies in terms of their punitive nature and the strength of the sanctions imposed, the Air Force would likely rank first followed by the Navy and Marine Corps, with the Army providing the least punishment of all. These differences in the services' provide a natural experiment for estimating deterrence effects. Moreover, it provides an alternative method to replicate the deterrence findings cited in Borack and Mehay [Ref. 5] and Borack [Ref. 7]. Recall though that both studies based their estimations on an unusually small number of time series observations. This thesis seeks to correct this deficiency by using micro-data on individuals drawn from two separate 1995 surveys, the Department of Defense Survey of Health Related Behaviors Among Military Personnel and National Household Survey on Drug Abuse.

IV. DATA SURVEYS

A. DEPARTMENT OF DEFENSE SURVEY OF HEALTH RELATED BEHAVIORS AMONG MILITARY PERSONNEL

The 1995 Department of Defense Survey of Health Related Behaviors Among Military Personnel (DODWWS) was conducted by the Research Triangle Institute under the sponsorship of the Office of the Assistant Secretary of Defense (Health Affairs). The 1995 study is the sixth in a series of DoD surveys of active-duty military personnel. The first was conducted in 1980 followed by surveys in 1982, 1985, 1988, and 1992 [Ref. 31]. The overall purpose of the survey is to, "...(a) improve understanding of the nature, causes, and consequences of substance use and health in the military; (b) determine the appropriateness of the emphasis placed on program elements; and (c) examine the impact of current and future program policies" [Ref. 32]. In addition, the two broad goals of the 1995 survey were to continue the survey of substance use among active-duty military personnel, and to establish baseline data to assess progress toward selected DoD health objectives for active-duty military personnel. As a result, the 1995 DODWWS provides comprehensive and detailed estimates of the prevalence of alcohol, illicit drug, and tobacco use within the military services [Ref. 31].

The 1995 DODWWS survey was based on a two-stage cluster design to ensure the sample was representative of the worldwide active-duty force. The first-stage of the sampling procedure consisted of information by military

installation separated by service and geographic location. The second-stage was comprised of randomly selected military personnel, stationed at the same military installations identified in the first stage, stratified by rank and gender. The survey was crafted in this manner in order to, "...achieve cost efficiency while preserving the inferential capability of the sample" [Ref. 31].

However, some groups were not included in the sampling. The eligible population for the DODWWS was limited to all active-duty military personnel except recruits, service academy students, those absent without official leave, and service members who were in the midst of a permanent change of station at the time of the survey. Eligible personnel completed a survey questionnaire during one of two phases. In phase one, civilian field survey teams administered the test in group settings at 59 military installations from April through August 1995. During phase two, the teams mailed the questionnaires to eligible personnel who were not available during phase one. The survey medium was a self-administered questionnaire that contained measures of selected aspects of substance abuse and other health behaviors. Approximately 88 percent of the responses were obtained during phase one [Ref. 31]. The overall response rate for the eligible population was 69.6 percent. The final 1995 DODWWS data set consists of 16,193 observations (3,638 Army, 4,265 Navy, 3,960 Marine Corps, and 4,330 Air Force) with 395 variables that pertain to illicit drug, alcohol, and tobacco use within the military. As alluded to previously, the 1995 DODWWS will be utilized to specify a statistical model to estimate the

deterrence effect associated with differences in the military services' drug testing policies.

B. NATIONAL HOUSEHOLD SURVEY ON DRUG ABUSE

The 1995 National Household Survey on Drug Abuse (NHSDA) is the 15th in a series of annual studies designed to measure the prevalence and correlates of drug use in the United States and to monitor drug use trends over time. The survey began in 1971 under the control of the National Commission on Marijuana and Drug Abuse. Today, responsibility for conducting and preparing the NHSDA resides with the Office of Applied Studies within the Substance Abuse and Mental Health Services Administration (SAMSHA), a branch of the U.S. Department of Health and Human Services. [Ref. 2]

The primary purpose of the NHSDA is to "...measure the prevalence and correlates of drug use in the United States" [Ref. 33]. Specifically, it provides information about the use of illicit drugs, alcohol, and tobacco among members of the non-institutionalized U.S. civilian population age 12 or older. As such, the NHSDA excludes from its survey population those with no addresses, residents of institutional quarters (e.g., prison and hospitals), and active duty military personnel [Ref. 33].

The sample for the 1995 NHSDA was designed so that study results could be used to make inferences about the target population. The survey sample design was based on a stratified, multi-stage area probability sample consisting of 115 primary sampling units (PSU) [Ref. 34]. A PSU was

comprised of counties within states or groups of counties (e.g., metropolitan areas) [Ref. 2]. Furthermore, the "…design uses a composite size measure methodology and a specially designed within-dwelling selection procedure to ensure that desired sample sizes would be achieved for sub-populations defined by age and race/ethnicity" [Ref. 33]. Specifically, segmented areas were selected with unequal probability designed to over-represent Hispanic and Black neighborhoods to ensure adequate sample sizes were obtained.

Survey data were collected through personal visits to selected residences. Initially, a short voluntary screening was conducted with each resident. The primary purpose was to gather information on age, race/ethnicity, gender, marital status, and smoking status of the occupants. This information was then used to randomly select residents for a follow on, in-depth interview. Probability of selection was based on the ethnicity of the head of household, and age and current smoking status of each household member. Either one, two, or no individuals were selected with interviewers having no control over the selection process. If selected for a follow-on conference, NHSDA field representatives conducted interviews using a questionnaire that included both interviewer and self-administered answer sheets for the collection of sensitive information. All screening and interview questions were kept confidential. Response rates for screening and interviewing were 94.2 percent and 80.6 percent, respectively. [Ref. 34]

The final 1995 NHSDA data set consists of 17,747 observations (22,016 were eligible) with 1,250 variables that pertain to illicit drug, alcohol, and tobacco use within the non-institutionalized U.S. civilian population age 12 and older. It is the intent of this thesis to use the 1995 NHSDA data to estimate the deterrence and substitution effects of the military services' drug testing policies by comparing use rates of military members with a representative sample of the civilian survey respondents. One natural experiment involves comparing use rates for individuals subject to testing (military personnel) to individuals who are not tested (civilians).

C. SURVEY LIMITATIONS

Although both surveys contain extremely useful sample data that can illuminate the prevalence of drug use within their respective target populations, the DODWWS and NHSDA do have certain limitations for the purposes of this thesis.

First, both surveys depend on self-reporting, the willingness of the individual to truthfully and accurately report their drug use. To do otherwise would subject the survey to under or over-reporting bias based on the circumstances of the situation. For example, if respondents fear that the information they provide will be used against them, they may be inclined to under-report their actual drug use. This situation results in faulty estimates, which would distort the true prevalence rate of civilian and military drug use. "A conclusion drawn from

studies done by Rouse, Kozel, and Richards is that self-reported data can be trusted if the individual feels that his or her privacy will be protected and that there is a valid reason for the study" [Ref. 35]. To prevent this bias from occurring, both surveys have taken measures during the data collection phase to ensure respondents of not only the validity of the survey but also of the confidentiality of their responses.

Both surveys are cross-sectional and not longitudinal; they interview individuals once and not at different points in time as in a longitudinal study. The limitation for this study is that the NHSDA and DODWWS can only provide the prevalence of drug use at a specific point in time. In a true panel study, the respondents are interviewed and tracked as a group (cohort) over time so that each individual's drug use can be observed over time. Simply put, the NHSDA and DODWWS provide useful data but not as detailed as panel data. Thus, the inferences that are drawn from the NHSDA and DODWWS data may be limited.

Lastly, both studies place limitation on the survey respondents by excluding a small portion of the population. If the drug use of this omitted group differs substantially from that of the sample population, it may cause slightly inaccurate estimates of drug use in the total population. This would lead to estimates that would over or under-estimate the true prevalence rate of illicit drug use especially for rarely used drugs such as heroin. In the case of the NHSDA, the omitted population is limited to less than two percent of the total population. [Ref. 2]

V. METHODOLOGY

A. PURPOSE

In devising their conceptual model for determining an optimal drug testing strategy, Borack and Mehay hypothesized and established a link between the frequency of drug testing and deterrence [Ref. 5]. However, their results were based on limited time series data. Replication of their results using alternative data and methodologies is required. This process is necessary before the true benefits of drug testing programs can be established. Therefore, the goal of this thesis is to provide one such alternative method of replication.

It has already been established that each service has a unique drug testing program of varying frequency and intensity. This fact provides the foundation from which to either confirm or refute the findings of Borack and Mehay. This will be accomplished by assessing the strength of the deterrence effect associated with differences in the individual services' drug testing policies, and differences between the military's policies and those in the civilian sector.

B. THEORETICAL MODEL

One alternative method to model illicit drug use is to create a binary variable based on reported drug use set equal to one when the drug is used and zero otherwise. When the dependent variable of a model is specified in this

manner, logit-type models are appropriate [Ref. 36]. Therefore, several multivariate logit models were developed that determined the difference in inclination for drug use. Specifically, the models yield the expected proportion of illicit drug users based on factors within a comparable subset of the civilian and military survey sample.

As already cited in Borack and Mehay, military personnel are recruited from the civilian sector and can be segmented by age, sex, race, geographic location, socio-economic status, and other factors related to the likelihood of using illegal drugs [Ref. 5]. Consequently, the logit models utilize many of the demographic characteristics cited above. As with the dependent variables, these independent variable categories were also defined as binary variables, set equal to one if it was a characteristic of the respondent or zero, if not. Separate analyses of the 1995 DODWWS and a merged data file containing similar variables from both the NHSDA and DODWWS were performed in order to obtain model estimates. The resulting parameter estimates were interpreted as the change in the log odds of the dependent variable equaling one (as opposed to zero), given a one-unit change in the independent variable, holding all other explanatory variables constant [Ref. 36].

C. MODEL SPECIFICATION

To accomplish the objectives of this thesis, the analysis portion of the study was segregated into two distinct categories. Each division investigated a specific

segment of the overall analysis. Given this, each section required the specification of unique logit regression models suited to the issue being examined. Differences among these models were primarily confined to dependent variable discriminations. The exact model specification as well as the details of the issues examined in each phase of the thesis is presented in the third sub-division of this section. The purpose of the following two sections is to highlight model specification issues generic to all models used in this study.

1. Variable Description

The model variables specified for use in the analysis were chosen based on three factors. These included: (1) analysis of past studies (i.e., literature review); (2) hypothesized factors related to the propensity of using illegal drugs; and (3) the compatibility of available variables in both the DODWWS and NHSDA data sets.

As alluded to earlier, all the model variables utilized were portrayed as binary dummy variables. They were coded as a one if the respondent was in the category or the event was true, or as a zero if otherwise. Additionally, similar variables were defined and created from both the NHSDA and DODWWS data files and subsequently merged into a single data set in order to facilitate the statistical analysis. In some cases, a specific variable was further sub-divided in order to analyze if behavior was different for various demographic sub-groupings.

Depending on the specific phase of the analysis, the dependent variables were chosen because they provided

information pertaining to a respondent's illicit drug use during the past 30 days, and in some cases, during the past year. The past 30-day use variable was chosen because the military as a whole is primarily concerned with recent drug use and, as a result, tests for current, not past use. For example, if an individual used illicit drugs last year, while a high school senior, it would not have any effect on the results of the Navy's drug testing presently being conducted. However, a past-year use variable was also included in order to ascertain the effect the various service drug testing programs have upon long-term illegal drug use.

The independent variables were chosen based primarily on the literature review and to provide tests of the hypothesized effects on the likelihood of using illegal drugs. Additionally, in order to measure the deterrence effect of comparable civilian and military respondents, the availability of each variable in both the NHSDA and DODWWS studies was of paramount importance. Explanatory variables included marital status, educational level, age, race, gender, and status (military or civilian). Tables 5.1 and 5.2 provide a description of the dependent and independent variable definitions, respectively, as well as variable names. These names are used in the following discussion.

Table 5.1 Dependent Variable Definitions

VARIABLE	DEFINITIONS
DRUG30	If the respondent used any illicit drugs during the past month.
DRUG12	If the respondent used any illicit drugs during the past year.

Source: DODWWS and NHSDA Model

Table 5.2 Independent Variable Definitions

VARIABLE	DEFINITIONS
SINGLE	If the respondent is currently divorced, separated, or single.
MARRIED	If the respondent is married.
NOHSD	If the respondent has no high school diploma.
GED	If the respondent has a GED or alternate education degree.
HSDG	If the respondent has a traditional high school diploma.
HSGED	If the respondent has a GED or HSDG (Combined for officer models only)
SOMCOLL	If the respondent has attended some college, but did not complete a degree.
COLLGRAD	If the respondent has a college degree.
AGE1	If the respondent is between the ages of 17 through 20.
AGE2	If the respondent is between the ages of 21 through 25.
AGE3	If the respondent is between the ages of 26 through 34.
AGE4	If the respondent is between the ages of 35 through 49.
WHITE	If the respondent is White.
BLACK	If the respondent is Black.
HISPANIC	If the respondent is Hispanic.
OTHRACE	If the respondent is not White, Black, or Hispanic with regard to their race.
MALE	If the respondent is a male.
FEMALE	If the respondent is a female.
JENL	If the respondent is a junior enlisted service member (E1 through E3).
ENL	If the respondent is an enlisted service member (E4 through E6).
SENL	If the respondent is a senior enlisted service member (E7 through E9).
WOFF	If the respondent is a warrant officer in the armed forces (W1 through W5).
JOFF	If the respondent is a junior officer in the armed forces (O1 through O3).
SOFF	If the respondent is a senior officer in the armed forces (O4 through O10).
ARMY	If the respondent is an active duty member of the Army.
NVMC	If the respondent is an active duty member of the Navy or Marines.
USAF	If the respondent is an active duty member of the Air Force.
MILITARY	If the respondent is an active duty member of the U.S. Military
CIVILIAN	If the respondent is a member of the non-institutionalized civilian population.
CONUS	If the respondent is serving at a duty station inside the continental U.S.
OCONUS	If the respondent is serving at a duty station outside the continental U.S.

Source: DODWWS and NHSDA Model

Tables 5.3 and 5.4 provide the mean values and standard deviations of the variables illustrated in Tables 5.1 and 5.2. In order to determine if illicit drug usage rates vary substantially, the estimated deterrence coefficients generated for this thesis were segregated by rank. As such, Tables 5.3 and 5.4 depict the variable information pertaining to the enlisted and officer ranks respectively.

Table 5.3 Enlisted Variable Means

VARIABLE	N	MEAN	STD DEV	SUM
DRUG30	12,847	0.02603	0.15922	325
DRUG12	12,492	0.05604	0.23000	700
SINGLE	12,495	0.37711	0.48468	4,712
MARRIED	12,495	0.62289	0.48468	7,783
NOHSD	12,495	0.00440	0.06620	55
GED	12,495	0.02569	0.15822	321
HSDG	12,495	0.36927	0.48263	4,614
SOMCOLL	12,495	0.52741	0.49927	6,590
COLLGRAD	12,495	0.07323	0.26052	915
AGE1	12,495	0.12845	0.33461	1,605
AGE2	12,495	0.27347	0.44576	3,417
AGE3	12,495	0.25746	0.43725	3,217
AGE4	12,495	0.34062	0.47394	4,256
WHITE	12,495	0.64274	0.47921	8,031
BLACK	12,495	0.19384	0.39532	2,422
HISPANIC	12,495	0.09244	0.28965	1,155
OTHRACE	12,495	0.07099	0.25682	887
MALE	12,495	0.81176	0.39092	10,143
FEMALE	12,495	0.18824	0.39092	2,352
JENL	12,495	0.24922	0.43258	3,114

Source: DODWWS Model

Table 5.3 Enlisted Variable Means (Continued)

ENL	12,495	0.40136	0.49019	5,015
SENL	12,495	0.34942	0.47681	4,366
ARMY	12,495	0.20976	0.40716	2,621
NVMC	12,495	0.51028	0.49991	6,376
USAF	12,495	0.27995	0.44899	3,498
CONUS	12,495	0.77463	0.41784	9,679
OCONUS	12,495	0.22537	0.41784	2,816

Source: DODWWS Model

Table 5.4 Officer Variable Means

VARIABLE	N	MEAN	STD DEV	SUM
DRUG30	3,571	0.00840	0.09128	30
DRUG12	3,571	0.01652	0.12749	59
SINGLE	3,572	0.21892	0.41358	782
MARRIED	3,572	0.78108	0.41358	2,790
HSGED	3,572	0.03052	0.17202	109
SOMCOLL	3,572	0.11842	0.32315	423
COLLGRAD	3,572	0.85106	0.35608	3,040
AGE2	3,572	0.08007	0.27144	286
AGE3	3,572	0.33315	0.47140	1,190
AGE4	3,572	0.58679	0.49248	2,096
WHITE	3,572	0.83959	0.36704	2,999
BLACK	3,572	0.06719	0.25038	240
HISPANIC	3,572	0.04843	0.21471	173
OTHRACE	3,572	0.04479	0.20688	160
MALE	3,572	0.83007	0.37563	2,965
FEMALE	3,572	0.16993	0.37563	607
WOFF	3,572	0.17553	0.38047	627
JOFF	3,572	0.38438	0.48652	1,373
SOFF	3,572	0.44009	0.49647	1,572
ARMY	3,572	0.27324	0.44568	976
NVMC	3,572	0.50252	0.50006	1,795

Source: DODWWS Model

Table 5.4 Officer Variable Means (Continued)

USAF	3,572	0.22424	0.41714	801
CONUS	3,572	0.81691	0.38680	2,918
OCONUS	3,572	0.18309	0.38680	654

Source: DODWWS Model

2. Hypothesized Relationships

The hypothesized signs of the explanatory variables were also based on the literature review. As opposed to single respondents, married individuals are usually older, have families, and increased responsibilities which make them less likely to use drugs. Those who fail to complete high school, NOHSD or GED, would be more likely to use drugs. The rationale here is that non-high school graduates are usually young and immature, and demonstrate an inability to complete a task (non-completion of high school indicates lack of commitment). Conversely, individuals who go to college, SOMCOLL or COLLGRAD, would be less likely to use drugs. These are usually forward-looking, educated people who should be profoundly aware of the adverse physical and psychological effects of illicit drugs use. However, younger individuals are more likely to be drug users, especially those in categories AGE1 (17-20 years old) and AGE2 (21-25 years old) for reasons already described. Older age groups should be less likely to use drugs, especially those in category AGE4 (35-50 years old). This generalization is based on the increased knowledge, maturity, and responsibility that usually characterizes older people.

A respondent's race is also theorized to be an important predictor of drug use. Minorities (BLACK,

HISPANIC) are more likely exposed to an environment where drugs are readily available, especially if bleak employment and financial difficulties are prevalent. Residing in an area of increased gang activity would also increase drug use, because it is often a part of gang life. However, despite this anecdotal evidence, it is hypothesized that the third minority group, OTHRACE, would be less likely to use drugs because of their different cultural backgrounds. With regards to gender, it was hypothesized that males are more likely to use drugs than females, in part because males may be more likely to be risk-takers than risk-avoiders.

Lastly, and the main thrust of this thesis, it is hypothesized that military status will likely lead to lower drug use than that of a comparable civilian status. The rationale here is that the deterrence of drug testing which results from the severe penalty for detection will cause illicit drug usage to decline. In addition, prospective military applicants know that the services test for drugs and are aware of the penalties for being caught.

3. Hypothesis Testing Procedure

The variables identified in Tables 5.1 and 5.2 were constructed by re-coding similar, existing variables contained within both the NHSDA and DODWWS surveys. In order to form the civilian variables so that they were representative of the DODWWS Navy population, observations from the NHSDA survey of respondents below the age of 17 were deleted. This was necessary because the DODWWS did not contain any observation for individuals under the age

of 17. Additionally, respondents age 50 or older were deleted from both the NHSDA and DODWWS data sets. The reason for this omission is that only a small, negligible portion of the DODWWS respondents was above the age of 50. As such, this age category (50 through 67 years old) omission was not expected to adversely impact the model results.

After analyzing the DODWWS data files separately, identical variables were constructed from both studies and merged into a single data set for analysis. Since all variables identified were binary, the resulting logit estimates were derived using non-linear maximum likelihood techniques [Ref. 37]. In addition to the logit parameter estimates, a marginal analysis was performed in order to reveal how much more likely a person is to use drugs if they possess a certain attribute, such as a college degree as opposed to a high school degree. The analysis was conducted in two distinct phases.

a. Phase One

Utilizing data from the 1995 DODWWS, service-specific rates of illicit drug use were modeled as a function of appropriate demographic characteristics of the survey respondents. Estimates of the deterrence effect were based on two scenarios. In the first scenario, all four services are included in the sample and the illicit drug use rates of the Air Force and Navy/Marine Corps are compared to the base service, the Army. In the second scenario, the Air Force is excluded from the sample and the Navy and Marine Corps is compared to the Army.

Furthermore, the estimates were segregated by rank in order to determine if usage rates vary substantially across the officer and enlisted communities. The main focus of this portion of the analysis concerned estimation of the deterrence effect based on differences in drug testing policies between the service groupings.

b. Phase Two

In order to perform the final segment of the analysis, similar variables from both the 1995 DODWWS military survey and the 1995 NHSDA civilian survey were combined to create a merged data set with common variables. This merged data set was required because the main focus of this portion of the investigation was to estimate the deterrence effects by comparing use rates of military members with a representative sample of the civilian survey respondents not subject to drug testing. This civilian-military comparison was divided into two segments as outlined below:

- Utilizing the new merged data set, a model was created that estimated the overall deterrence effect associated with military drug testing as compared to a representative proportion of the civilian population not subject to drug testing.

- Utilizing the new merged data set, a model was created that estimated the deterrence effect associated with each service as compared to a representative proportion of the civilian population not subject to drug testing. The main focus concerned prevalence rates in the civilian population versus the individual services.

The hypothesis testing procedure outlined above specifies the multivariate models pertaining to the deterrence effects of both the individual military services' drug testing policies as well as that of the overall military. Chapter VI details the results of the methodology employed in measuring the main thrust of this thesis, which is to measure the deterrence effect of the military services' drug testing programs.

VI. DETERRENCE EFFECT ANALYSIS

The focal point of this thesis involves determining if there is a deterrence effect associated with the military services' drug testing programs. Since an important goal of the individual service policies is to deter drug use, the existence and magnitude of the deterrence effect must be verified before the program's true benefits can be established. Additionally, the results of this analysis will either corroborate or refute the drug testing deterrence findings of Borack and Mehay [Ref. 5], and Borack [Ref. 7].

The deterrence effect is measured over both long- and short-term periods. For the purposes of this analysis, short-term is defined as illicit drug use during the past 30 days (DRUG30), whereas long-term is defined as illicit drug use during the past 12 months (DRUG12). The rationale for analyzing two different time periods is to determine whether the deterrence effect holds for only a short period or for a longer period. The specific illicit drug types categorized for this analysis are:

> Marijuana/hashish; cocaine; crack; hallucinogens; inhalants; PCP; heroin; non-medical use of any psychotherapeutic; non-medical use of stimulants; non-medical use of sedatives; non-medical use of tranquilizers; non-medical use of analgesics; and "designer" drugs.

A. SERVICE-SPECIFIC DETERRENCE EFFECTS

Estimation of deterrence effects is based on the natural variations in the drug testing policies of the military services. As established, the services enforce drug testing policies that differ with respect to intensity and frequency. Also, the penalties imposed for confirmed drug use vary by service. A review of these policies revealed that the Air Force has the strictest program, followed by the Navy/Marines, and then the Army. It is hypothesized that the size of the deterrence effect will be greater for the program with the stricter policy. To confirm this, rates of illicit drug use were modeled as a function of appropriate demographic characteristics and service-specific dummy variables. Using data from the 1995 DODWWS, the models produced deterrence estimates for the respective drug testing programs as well as estimates of the effect of the various demographic attributes on drug use. Since DoN's policy concerning illicit drug use governs both the Navy and Marine Corps, their respective programs are very similar. As such, these programs were combined and the deterrence effect of both policies was estimated

Estimates of the deterrence effect were based on two alternative strategies. We first include all four services in the sample and compare the Air Force and Navy/Marine Corps observations to the comparison service, the Army. In the second comparison, we omit the Air Force observations and again compare the Navy/Marine Corps to the Army. These particular groupings were analyzed because the penalties

imposed by the Air Force are greater than they are for the other services. But, unfortunately, it is difficult to identify whether differential drug use in the Air Force is due to deterrence or, instead, due to selection bias associated with the quality and propensity of recruits entering the Air Force versus the other services. Thus, the second comparison omits the Air Force and compares the Navy and Marine Corps to the Army. Because drug policies in the Navy/Marine Corps are stricter than those in the Army, we expect to also observe a deterrence effect in the second comparison. If the coefficient in the second comparison differs significantly from the coefficient in the first comparison, this suggests that there may be selection bias when the Air Force is included in the sample. In addition to the strategies described, the estimates were further isolated by rank in order to determine if usage rates vary across the officer and enlisted communities.

In analyzing the deterrence effect for the first comparison, the following models were specified:

Enlisted Drug Use Model

DRUG30 (DRUG12) = f(NVMC, USAF, JENL, ENL, MALE, SINGLE, BLACK, HISPANIC, OTHRACE, AGE1, AGE2, AGE3, NOHSD, GED, SOMCOLL, COLLGRAD, CONUS) (EQ.1)

Officer Drug Use Model

DRUG30 (DRUG12) = f(NVMC, USAF, JOFF, WOFF, MALE, SINGLE, BLACK, HISPANIC, OTHRACE, AGE2, AGE3, HSGED, SOMCOLL, CONUS) (EQ.2)

Where NVMC = 1 for Navy and Marine Corps members and USAF = 1 for Air Force members.

The major differences between the models concerns the omission of two variables from the officer models. It was observed that there were no officer observations in the NOHSD category. Additionally, no officers in the sample were between the ages of 17 through 20 (AGE1). As a consequence, these variables were not included in the officer model. Additionally, the GED and HSDG categories were combined to form a HSGED category for the officer analysis. Only a very small number of officers' highest academic achievement was a GED or high school diploma.

Table 6.1 details the logit coefficients of EQ.1 and EQ.2 with standard errors in parentheses. The parameter estimates are interpreted as the change in the log-odds of illicit drug use given a one-unit change in the independent variable, holding all other explanatory variables constant.

With regards to enlisted personnel, columns 1 and 2 of Table 6.1 reveal that rank (JENL and ENL) has a significant and positive impact on illicit drug use both in the short- and long-term. In addition, respondents in the SINGLE, AGE2 (ages 21 through 25), GED, and CONUS categories all have significant and increased odds of illicit drug use for both the last 30 days and the last 12 months. A positive effect on drug use was also found for males and those between the ages of 17 through 20 (AGE1). However, these effects were only significant for long-term (12-month) use. The only significant and negative demographic coefficient was race (BLACK) but its significance was limited to drug use during the past 12 months.

Table 6.1 Logit Estimates of Drug Testing Deterrence Effect (Navy/Marine Corps, Air Force versus Army)

INDEPENDENT VARIABLES		ENLISTED DRUG USE		OFFICER DRUG USE	
		DRUG30	DRUG12	DRUG30	DRUG12
NVMC		-0.2422* (0.1327)	-0.3793*** (0.0939)	0.2929 (0.4660)	0.1878 (0.3224)
USAF		-1.3144*** (0.2023)	-1.2432*** (0.1320)	-0.1270 (0.6053)	-0.6992 (0.4698)
JENL	JOFF	1.2686*** (0.3088)	1.3884*** (0.2257)	0.9130* (0.5315)	0.9937** (0.3976)
ENL	WOFF	0.7635*** (0.2717)	0.8337*** (0.2004)	-0.0843 (0.7311)	-0.2482 (0.5717)
MALE		0.1505 (0.1473)	0.2248** (0.1046)	-0.1926 (0.4698)	-0.2390 (0.3308)
SINGLE		0.6024*** (0.1334)	0.4668*** (0.0925)	0.6777 (0.4265)	0.7697*** (0.2982)
BLACK		-0.1329 (0.1605)	-0.2335** (0.1142)	0.8522 (0.5638)	0.4930 (0.4509)
HISPANIC		0.1387 (0.1786)	-0.0514 (0.1326)	1.2676** (0.5654)	1.0678** (0.4240)
OTHRACE		0.0172 (0.2268)	-0.1159 (0.1658)	0.9341 (0.6326)	0.4750 (0.5353)
AGE1		0.4855 (0.3238)	0.8493*** (0.2338)	N/A	N/A
AGE2		0.5549* (0.2887)	0.7334*** (0.2107)	-1.9855* (1.1132)	-0.8672 (0.5480)
AGE3		0.1722 (0.2674)	0.1768 (0.1973)	-1.0932** (0.5393)	-0.8854** (0.3902)
NOHSD	HSGED	-0.6161 (1.0193)	0.0215 (0.5386)	0.1746 (1.1620)	0.8006 (0.7291)
GED		1.0218*** (0.2623)	0.8251*** (0.2091)	N/A	N/A
SOMCOLL		0.0859 (0.1308)	0.0916 (0.0919)	0.6356 (0.6650)	0.3995 (0.5296)
COLLGRAD		-0.00329 (0.3320)	-0.0176 (0.2424)	N/A	N/A
CONUS		0.4483*** (0.1532)	0.4267*** (0.1055)	-0.1168 (0.4662)	0.0838 (0.3567)
CONSTANT		-5.2261*** (0.3092)	-4.4973*** (0.2201)	-5.1172*** (0.7138)	-4.4628*** (0.5164)
Concordance Ratio		73.9%	76.0%	67.1%	66.9%
Sample Size		12,487	12,492	3,541	3,571

Source: DODWWS Enlisted and Officer Drug Use Models (EQ.1 and EQ.2).
*** Significant at 99 percent level of confidence; ** Significant at 95 percent level of confidence; * Significant at 90 percent level of confidence. N/A - Not Applicable.

The results for officers in Columns 3 and 4 of Table 6.1 were mixed. While JOFF (rank) was positive and significant for both time periods, the WOFF variable was not. Additionally, the magnitude and level of significance of the estimated JOFF coefficient was smaller than the JENL coefficient. Not surprisingly, service members in category AGE3 (26 through 34) were less inclined to use drugs. Hispanic officers were prone to significantly higher rates of illicit drug use regardless of time period. Being a single officer was associated with higher drug use. However, this estimated coefficient was only significant for drug use in the last 12 months. The sole surprise encountered was the negative coefficient for short-term drug use among 21 through 25 year old officers (AGE2). Despite its significance at the 90 percent level of confidence, the accompanying large standard error casts doubt upon the reliability of this result.

The most pertinent coefficients for this portion of the analysis is the deterrence effect associated with the drug testing policies of the Air Force and Navy/Marine Corps, which is captured by the USAF and NVMC variable, respectively. As stated earlier, if the hypothesis being tested is supported, less stringent drug policies would produce smaller deterrence effects. In order to establish if the deterrence effect of the Air Force's strict drug testing policy is greater than that of the other services, a comparison of program rates must be made.

In the officer ranks, the USAF deterrence effect estimate is negative for both short- and long-term drug use, while the opposite is true for the NVMC estimate.

However, a more notable finding than the conflicting results is that none of the four officer deterrence estimates were statistically significant. In contrast, Table 6.1 shows the enlisted deterrence effect of the Air Force is relatively large, negative, and significant to a high degree of confidence for both 30-day and 12-month use. This result also holds true for the Navy and Marine Corps. However, the magnitude of the deterrence estimate is smaller than for the Air Force estimate. The preceding enlisted results seem to confirm the hypothesis that the drug testing policy of the stricter service (the Air Force) generates a larger deterrence effect. However, the large, negative coefficient associated with the Air Force may not be wholly attributable to its drug testing policy.

Participation in the armed forces is a voluntary endeavor. Prospective military applicants choose a service based on myriad factors, including ability and motivation. If the Air Force consistently attracts certain recruit types (e.g., more able) at the expense of their sister services, then for the purpose of this analysis a selection bias may be introduced. This would be especially true if the prospective Air Force applicants exhibited lower propensities to use illicit drugs because of their unobserved characteristics rather than because of the Air Force's drug policies. If so, the estimated coefficient associated with the Air Force dummy variable would overstate the true impact of the drug testing program.

To identify if a bias exists, the deterrence effect of Navy and Marine Corps drug policies was estimated separately by comparing it to the Army after omitting the

Air Force observations. A self-selection bias will become evident if the NVMC variable estimate from the second comparison is substantially different from that in the first comparison.

To estimate the Navy and Marine Corps drug testing deterrence for the second strategy, the following models were specified:

Enlisted Drug Use Model

DRUG30 (DRUG12) = f(NVMC, JENL, ENL, MALE, SINGLE, BLACK, HISPANIC, OTHRACE, AGE1, AGE2, AGE3, NOHSD, GED, SOMCOLL, COLLGRAD, CONUS) (EQ.3)

Officer Drug Use Model

DRUG30 (DRUG12) = f(NVMC, JOFF, WOFF, MALE, SINGLE, BLACK, HISPANIC, OTHRACE, AGE2, AGE3, HSGED, SOMCOLL, CONUS) (EQ.4)

Where NVMC = 1 for Navy and Marine Corps members.

Table 6.2 incorporates the results of the estimated coefficients from EQ.3 and EQ.4 above with corresponding standard errors in parentheses. As in the earlier analysis, the coefficients are interpreted as the change in the log-odds of illicit drug use given a one-unit change in the independent variable, holding all other explanatory variables constant.

In examining Table 6.2, many of the same demographic characteristics that were significant in Table 6.1 were also important in this analysis. Regarding short- and long-term enlisted drug use, JENL, ENL, SINGLE, GED, and CONUS variables revealed positive and significant effects on drug use. Also, being male or 17 through 25 years old

(AGE1, AGE2) were positively correlated with drug use. However, the significance of these results was confined to drug use during the past 12 months. As in Table 6.1, the only significant and negative demographic coefficient was race (BLACK) but its significance was limited to drug use during the past 12 months. One difference between Table 6.2 when compared to Table 6.1 was that the short-term, positive effect of the AGE2 variable was not significant.

Most of the explanatory variables in the officer models were insignificant. HISPANIC was the only demographic category that was significant and positively correlated with illicit drug use in both timeframes. In addition, being single or a junior officer (SINGLE, JOFF) were both associated with an increased propensity for illicit drug use over the long term. The one difference between the results in Table 6.1 from that of Table 6.2 was that Black officers were more likely to participate in illicit drug use in the short term.

As stated earlier, the estimated coefficient of NVMC provides the desired measure of drug use deterrence associated with the Navy and Marine Corps drug policies. Table 6.2 shows that the propensity to engage in illicit drug use was similar to the coefficients estimated for the NVMC variable in Table 6.1. While the coefficients that were calculated in Table 6.2 are slightly larger for both time periods and both rank divisions, they are not substantially different. The inference that can be made from this result is that inclusion of the Air Force variable does not introduce any new selection bias.

Table 6.2 Logit Estimates of Drug Testing Deterrence Effect (Navy and Marine Corps versus Army)

INDEPENDENT VARIABLES		ENLISTED DRUG USE		OFFICER DRUG USE	
		DRUG30	DRUG12	DRUG30	DRUG12
NVMC		-0.2515* (0.1331)	-0.3923*** (0.0944)	0.3272 (0.4684)	0.1975 (0.3237)
JENL	JOFF	1.4858*** (0.3286)	1.4017*** (0.2445)	0.61425 (0.5995)	0.9632** (0.4353)
ENL	WOFF	0.9232*** (0.2894)	0.7900*** (0.2182)	-0.2972 (0.7595)	-0.2753 (0.5921)
MALE		0.2054 (0.1590)	0.2343** (0.1136)	-0.1661 (0.5411)	-0.2063 (0.3645)
SINGLE		0.5218*** (0.1423)	0.3935*** (0.1007)	0.5640 (0.4690)	0.7337** (0.3170)
BLACK		-0.1518 (0.1708)	-0.2821** (0.1235)	1.0749* (0.5778)	0.6541 (0.4573)
HISPANIC		0.1731 (0.1849)	-0.0432 (0.1397)	1.5195*** (0.5795)	1.2509*** (0.4310)
OTHRACE		0.0788 (0.2341)	-0.1101 (0.1774)	0.7391 (0.7644)	0.3333 (0.6135)
AGE1		0.4386 (0.3430)	0.9798*** (0.2580)	N/A	N/A
AGE2		0.4340 (0.3080)	0.8141*** (0.2352)	-13.4506 (399.5)	-0.7578 (0.5978)
AGE3		0.1591 (0.2849)	0.2666 (0.2177)	-0.7009 (0.5730)	-0.6573 (0.4096)
NOHSD	HSGED	-0.6477 (1.0197)	0.0146 (0.5407)	0.3075 (1.1738)	0.8817 (0.7365)
GED		1.0239*** (0.2644)	0.8217*** (0.2145)	N/A	N/A
SOMCOLL		0.0396 (0.1400)	0.0908 (0.0997)	0.7478 (0.6808)	0.4633 (0.5371)
COLLGRAD		0.0555 (0.3494)	-0.1377 (0.2830)	N/A	N/A
CONUS		0.4437*** (0.1632)	0.4738*** (0.1158)	-0.1261 (0.5122)	0.0571 (0.3785)
CONSTANT		-5.3017*** (0.3302)	-4.5587*** (0.2385)	-5.1445*** (0.7698)	-4.5686*** (0.5498)
Concordance Ratio		72.0%	75.2%	70.0%	65.5%
Sample Size		8,989	8,994	2,745	2,770

Source: DODWWS Enlisted and Officer Drug Use Models (EQ.3 and EQ.4).
*** Significant at 99 percent level of confidence; ** Significant at 95 percent level of confidence; * Significant at 90 percent level of confidence. N/A - Not Applicable.

However, some caution must be exercised in evaluating and interpreting the calculated coefficients. The main information that can be gleaned directly from the logit results in Tables 6.1 and 6.2 are the relative magnitude and directional effect of a specific explanatory variable on short- or long-term illicit drug use. For the estimates to be of any value, they must be assessed at a specific probability of occurrence. This is due to the fact that the model results were derived based on a logit model. "Since the logit model is nonlinear, the value of any particular derivative depends on where it is evaluated" [Ref. 38]. An alternative way to observe the effect of a change in an independent variable on the dependent variable is to calculate the marginal effect.

As it applies to this thesis, the marginal effect of a variable reveals how much more likely a person is to use drugs if they fall into a specific category (such as AGE1), holding all other variables constant. Creating a "notional" person and then evaluating the result after a given attribute is changed produces the marginal effect for that attribute. The notional respondent is someone who has all of the characteristics of the base case for the respective models being analyzed.

The enlisted model base case is a married, white, senior enlisted female between 35 and 49 years old who has earned a high school degree and is stationed outside the U.S. serving in the Army. The officer model base case is a married, white, female senior officer between 35 and 49 years old who has earned a college degree and is stationed outside the U.S. serving in the Army.

Table 6.3 provides only the marginal effects of the service-specific drug policy (i.e., the dummy variables for the services). Comprehensive marginal analysis for all of the explanatory variables are presented in Appendix A (Tables A.1 and A.2).

Rows 1 and 2 of Table 6.3 clearly indicates that, with respect to enlisted drug use, the deterrence rate of the Air Force drug testing program is larger than for the Navy/Marine Corps, which in turn is larger than for the Army policy. Recall that the base case service was the Army. If this "notional" person were in the Navy/Marine Corps instead of the Army, their propensity to engage in illicit drug use would decrease by .11 percent and .35 percent for 30-day and 12-month use, respectively. If instead, the notional person were in the Air Force as opposed to the Army, their 30-day and 12-month illicit drug use would decrease by .39 percent and .78 percent, respectively.

The interesting aspect of the results is that since all other explanatory variables are held constant, a possible explanation for the different use rates would be the individual services' drug testing programs. Given this, the marginal effects support the hypothesis that the stricter service policy (Air Force) produces the greatest deterrence effect. It should be noted that in both cases, the Air Force and Navy/Marine Corps deterrence rates are greater for 12-month use than for 30-day use. With regard to the timeframes specified in this thesis, these results imply that stricter policies tend to induce a larger deterrence effect regardless of timeframe.

Table 6.3 Marginal Effects of Drug Testing Deterrence[1]

	ENLISTED DRUG USE		OFFICER DRUG USE	
	DRUG30	DRUG12	DRUG30	DRUG12
NVMC (Table 6.1)	-0.11%*	-0.35%***	0.20%	0.23%
USAF (Table 6.1)	-0.39%***	-0.78%***	-0.07%	-0.57%
NVMC (Table 6.2)	-0.11%*	-0.33%***	0.22%	0.22%

Source: DODWWS Enlisted and Officer Drug Use Models (EQ.1 through 4).
[1] Percentage point difference in illicit drug use between base case and when selected attribute equals 1. *** Significant at 99 percent level of confidence; * Significant at 90 percent level of confidence.

In contrast, the officer drug use analysis reveals no consistent pattern of deterrence effect. All the marginal effects for officers presented in Table 6.3 are derived from insignificant logit coefficients. As such, the reliability of these marginal results are suspect. However, these results do provide substantiation for the argument that drug use rates within the officer community are not as prevalent as that of the enlisted ranks. As such, the deterrence effect of the drug testing programs on officers does not vary.

Table 6.3 also highlights the differences in the marginal effect of the NVMC variables estimated from Tables 6.1 and 6.2. Recall that the only difference between deterrence coefficients was the omission of the Air Force from the estimate reported in Table 6.2. The purpose of this elimination was to determine if the exclusion of the Air Force substantially changed the deterrence effect associated with the NVMC variable because of a suspected Air Force selection bias. As illustrated above, the marginal effects corresponding to the NVMC variables are virtually identical, which implies that no new selection

biases existed in the original sample that included the Air Force. However, some selection bias is possible due to the individual's ability to choose a particular service. It is not possible given the data to control for this original source of bias.

B. MILITARY VERSUS CIVILIAN DETERRENCE EFFECT

Up to this juncture, the analysis has estimated the deterrence effect by exploiting differences in drug policies among the services. The main intent of this portion of the thesis concerns estimation of deterrence effects by comparing use rates of military members with a representative sample of civilians who are not subject to drug testing. As outlined in the previous chapter, to perform this segment of the analysis, similar variables from both the 1995 DODWWS military survey and the 1995 NHSDA civilian survey were combined to create a merged data set of common variables. In constructing the civilian comparison group from the NHSDA, active duty military and military reservists were omitted. The merged data set was then utilized to compare military versus civilian illicit drug use. This comparison was accomplished in two segments:

- Estimate the deterrence effect associated with the drug testing policies of all military services as compared to a representative sample of the civilian population not subject to drug testing.

- Estimate the deterrence effect associated with individual military services as compared to a representative sample of the civilian population not subject to drug testing.

The estimates of the specific military services mentioned in the second segment above primarily concerned comparing the Army, Navy/Marine Corps, and Air Force to civilians. This comparison was based on differences in the services' drug testing programs with those of the civilian sample not subject to testing.

In determining the drug use deterrence estimates for the overall military scenario as well as the particular service groupings, two alternative models were estimated:

All Military versus Civilians

DRUG30 (DRUG12) = f(MILITARY, FEMALE, MARRIED, BLACK, HISPANIC, OTHRACE, AGE2, AGE3, AGE4, NOHSD, HSDG, SOMCOLL, COLLGRAD) (EQ.5)

Individual Services versus Civilians

DRUG30 (DRUG12) = f(ARMY, NVMC, USAF, FEMALE, MARRIED, BLACK, HISPANIC, OTHRACE, AGE2, AGE3, AGE4, NOHSD, HSDG, SOMCOLL, COLLGRAD) (EQ.6)

Table 6.4 details the coefficients estimated from the military versus civilian model specified above.

With regard to the military versus civilian comparison (EQ.5), columns 3 and 4 of Table 6.4 show that virtually all of the demographic variables have highly significant coefficients. The exception to this is the OTHRACE, AGE3, and SOMCOLL variables in the 30-day drug use rate (DRUG30). With regards to the overall military deterrence effect,

Table 6.4 Logit Estimates of Drug Testing Deterrence Effect (Service versus Civilian and Military versus Civilian)

INDEPENDENT VARIABLES	SERVICE V. CIVILIAN		MILITARY V. CIVILIAN	
	DRUG30	DRUG12	DRUG30	DRUG12
MILITARY	N/A	N/A	-1.4411*** (0.0715)	-1.2770*** (0.0528)
ARMY	-1.1649*** (0.1129)	-0.9351*** (0.0798)	N/A	N/A
NVMC	-1.2959*** (0.0835)	-1.1803*** (0.0619)	N/A	N/A
USAF	-2.3014*** (0.1652)	-2.0194*** (0.1088)	N/A	N/A
FEMALE	-0.5419*** (0.0518)	-0.4286*** (0.0405)	-0.5412*** (0.0517)	-0.4280*** (0.0405)
MARRIED	-0.8752*** (0.0657)	-0.8465*** (0.0492)	-0.8815*** (0.0656)	-0.8520*** (0.0491)
BLACK	-0.1743*** (0.0613)	-0.3041*** (0.0489)	-0.1653*** (0.0613)	-0.2898*** (0.0489)
HISPANIC	-0.4979*** (0.0687)	-0.5528*** (0.0539)	-0.4905*** (0.0688)	-0.5432*** (0.0539)
OTHRACE	-0.1425 (0.1334)	-0.2690*** (0.1042)	-0.1306 (0.1334)	-0.2552** (0.1041)
AGE2	0.2319*** (0.0775)	0.2439*** (0.0597)	0.2271*** (0.0776)	0.2365*** (0.0597)
AGE3	-0.0132 (0.0772)	-0.1259** (0.0602)	-0.0139 (0.0772)	-0.1265** (0.0601)
AGE4	-0.5578*** (0.0999)	-0.7440*** (0.0771)	-0.5461*** (0.0999)	-0.7327*** (0.0770)
NOHSD	0.4236*** (0.0878)	0.4111*** (0.0714)	0.4229*** (0.0879)	0.4100*** (0.0714)
HSDG	0.2516*** (0.0806)	0.3529*** (0.0633)	0.2641*** (0.0806)	0.3639*** (0.0633)
SOMCOLL	0.1774* (0.0927)	0.2444*** (0.0727)	0.1505 (0.0930)	0.2192*** (0.0727)
COLLGRAD	-0.4786*** (0.1150)	-0.2250*** (0.0853)	-0.4768*** (0.1151)	-0.2195** (0.0853)
CONSTANT	-1.7118*** (0.0558)	-1.1162*** (0.0453)	-1.7142*** (0.0559)	-1.1200*** (0.0453)
Concordance Ratio	74.5%	73.7%	74.1%	73.2%
Sample Size	32,845	32,850	32,845	32,850

Source: DODWWS/NHSDA Merged Data Set Drug Use Models (EQ.5 and EQ.6). *** Significant at 99 percent level of confidence; ** Significant at 95 percent level of confidence; * Significant at 90 percent level of confidence. N/A - Not Applicable.

particular note should be taken of the large, negative, and highly significant results for both the 30-day and 12-month rates. Since most individuals in the civilian sample work in organizations that do little drug testing, the differences in the use rates between the military and civilian sectors may be directly attributable to the military services' drug testing programs; that is, it represents the deterrence effect of the drug programs.

Columns 1 and 2 of Table 6.4 provide estimates of EQ.6. The information contained in Table 6.4 provides further evidence supporting the deterrence effect associated with the drug testing requirements of the military services. The interesting aspect in Table 6.4 is how the deterrence rate of the USAF variable is greater in magnitude than the NVMC variable, which in turn is greater than the Army variable. The reason this is important is because it furthers the argument that the deterrence rate is tied to the severity of the drug testing program. Yet, compared to the civilian sector, even the Army's program generates some deterrence. However, as stated earlier, logit coefficients only inform as to the size and direction of the effect. To directly compare how the introduction or omission of an independent variable will affect the dependent variable, marginal effects must be calculated.

The common denominator in all three models is the base case, which is a single, white, male between 17 and 20 years old who has earned a GED and is a member of the non-institutionalized civilian population. Table 6.5 provides the marginal effects based on Table 6.4. Comprehensive

marginal effects for all explanatory variables are available in Appendix B.

Table 6.5 highlights the fact that the military services' drug testing policies do deter drug use. Overall military past-year drug use is 12.26 percent lower than in the civilian sector. However, while the marginal effects of the pertinent drug deterrence coefficients are all negative and significant, they are not necessarily equal.

Table 6.5 Marginal Effects of Drug Testing Deterrence[1]

INDEPENDENT VARIABLES	DEPENDENT VARIABLE	
	DRUG30	DRUG12
ARMY	-9.96%***	-13.28%***
NVMC	-10.59%***	-15.53%***
USAF	-13.52%***	-20.51%***
MILITARY	-11.17%***	-12.26%***

Source: DODWWS and NHSDA Merged Data Set Drug Use Models
[1] Percentage point difference in illicit drug use between base case and when selected attribute equals 1. *** Significant at 99 percent level of confidence.

In examining the USAF and NVMC effects, it is clear that the Navy and Marine Corps drug testing program has a smaller deterrence effect than the Air Force's program and the Army's is smaller than the Navy's. This ranking confirms what we found in Table 6.1 and 6.2 when the services were compared to each other. Regardless of timeframe specified, the USAF marginal effect, which includes the Air Force, consistently exceeds the deterrence rate of the NVMC and ARMY variables.

A major goal of this thesis is to either corroborate or refute the findings of Borack and Mehay [Ref. 5] and Borack [Ref. 7], which assert a link between the frequency of drug testing and deterrence. Recollect that Borack and Mehay concluded that, as a direct result of the Navy's drug testing rate, 30-day illicit drug use among Navy personnel would decrease by six percent when compared to illicit drug use in the absence of testing. Table 6.5 shows that this thesis calculated the 30-day deterrence rate for the Navy/Marine Corps at roughly 10.6 percent. While these results cannot be directly compared due to the different sample populations, possible explanations can be offered to explain the difference in the magnitude of the deterrence effect estimates.

Assuming the Marine Corps deterrence rate is not substantially different than the Navy's, the disparity between the deterrence estimates here and in Borack and Mehay may be caused by the time series data used in the Borack and Mehay study. Because of a limited number of observations, Borack and Mehay may have underestimated the true deterrence effect of the Navy's drug testing program. However, a more plausible explanation is that this thesis may have overestimated the deterrence effect by not controlling for unobserved characteristics which have inappropriately been attributed to the military's drug testing programs. Inability to control for price and income also may have biased the results upward. Another issue that may have caused an overestimate would be that a selection bias exists with regards to the caliber and quality of personnel desiring to serve in the military.

However, despite these possible limitations, the underlying principle of Borack and Mehay concerning the deterrence effect caused by the Navy's drug testing program has been corroborated by the findings of this thesis.

Table 6.5 shows the overall and service specific deterrence associated with the military's drug testing program as compared to the civilian population not subject to testing. Without exception, a large, negative, and significant deterrence effect exists, which supports the findings of Borack and Mehay. Additionally, with regards to the service specific rates, the results confirm the findings of the Borack study, which concludes that the deterrence effect is affected by the frequency of testing.

VII. CONCLUSIONS AND RECOMMENDATIONS

A. CONCLUSIONS

The primary research question posed by this thesis was: What is the impact of the U.S. military's drug testing policies in deterring illicit drug use by military personnel? The results of this research indicate that the military services' drug testing policies have a significant impact in deterring illicit drug use when compared to a representative portion of the civilian population not subject to testing. Additionally, the research concluded that, among the respective services, this deterrence effect is influenced by the strictness of the drug policies. That is, service programs that test their personnel for illicit drugs with a greater intensity and frequency than their sister services tend to enjoy a higher deterrence rate. Lastly, this thesis corroborated two prior studies, Borack and Mehay [Ref. 5] and Borack [Ref. 7], which also found a link between the frequency of drug testing and deterrence.

In order to answer the primary research question stated above, the thesis was segregated into two specific areas of interest, service-specific and civilian versus military illicit drug use deterrence. Utilizing data from the 1995 Department of Defense Survey of Health Related Behaviors Among Military Personnel and the 1995 National Household Survey on Drug Abuse, overall and service-specific rates of illicit drug use were modeled as a function of pertinent demographic characteristics. The

model variables specified in the analysis were chosen based on three factors. These included: (1) analysis of past studies (i.e., literature review); (2) hypothesized factors related to the propensity of using illegal drugs; and (3) the compatibility of available variables in both the DODWWS and NHSDA data sets.

Non-linear maximum likelihood (logit) techniques were used to estimate the deterrence effects associated with differences among the service programs and with a representative sample of the civilian population not subject to drug testing. The deterrence effects were measured over both long- and short-term periods. For the purposes of this analysis, short-term was defined as illicit drug use during the past 30 days (DRUG30), whereas long-term was defined as illicit drug use during the past 12 months (DRUG12). Furthermore, with regard to service-specific models, the estimates were segregated by rank in order to determine if usage rates vary substantially across the officer and enlisted communities. A review of the individual services' drug testing programs revealed that the Air Force had the strictest policy followed by the Navy/Marine Corps and then the Army.

The service specific deterrence results indicated that, regardless of time frame, enlisted drug deterrence is greatest in the Air Force, followed by the Navy/Marine Corps, and then the Army. All the results were significant and followed the hypothesized ranking pattern with regards to the severity of the individual service drug testing programs. A second logit regression, which omitted Air Force personnel from the sample, did not result in any

substantial differences in the size of the deterrence effect for either the Navy/Marine Corps or Army. This result is important because it provides evidence that prospective Air Force applicants do not exhibit lower propensities to use illicit drugs because of unobserved characteristics, but rather that the difference in drug use is the Air Force's drug policies.

However, the drug deterrence results exhibited in the enlisted community were not duplicated in the officer ranks. Results show that there was no significant deterrence difference with respect to the unique drug testing policies of the services in either short- or long-term drug use among officers. These results were also observed in the second logit model that eliminated Air Force personnel.

In the second phase of the analysis, similar variables from both the 1995 DODWWS military survey and the 1995 NHSDA civilian survey were combined to create a merged data set containing common variables. This merged data set was required because the main focus of this portion of the investigation concerned estimation of the deterrence effects by comparing use rates of military members with a representative sample of the civilian survey respondents not subject to drug testing. As in the first phase of the analysis, two logit regression models were specified: overall military drug use versus civilian and service-specific drug use versus civilian.

The results of the overall military models indicate that military personnel are 11.2 percent and 12.3 percent less likely to use drugs than their civilian counterparts

for both short- and long-term drug use, respectively. The results of the service-specific analysis show that all the services have significantly lower rates of drug use than the equivalent civilian sample. However, the interesting aspect of this portion of the analysis was that regardless of short- or long-term drug use, the Air Force deterrence rate was largest, followed by the Navy/Marine Corps and then the Army. This ranking pattern confirms the results when the services were compared to each other, which was, regardless of timeframe specified, the Air Force consistently exceeded the deterrence rate of the Navy/Marine Corps and Army drug testing programs.

Finally, the results of the individual service versus civilian comparison was consistent with the earlier findings of Borack and Mehay [Ref. 5] and Borack [Ref. 7] which found a deterrence effect associated with the Navy's drug testing programs. It should be noted that in their study, Borack and Mehay determined that the Navy's drug testing program deters six percent of the Navy population from using illicit drugs that would otherwise engage in monthly drug use in the absence of testing. This thesis calculated a 12.6 percent deterrence rate for the Navy/Marine Corps drug testing programs. While these results cannot be directly compared, the limitations section of this thesis provides some possible explanation for the apparent disparity.

B. LIMITATIONS

The results of this thesis indicate a significant deterrence effect associated with the military services' drug testing programs. However, the contents of the data files utilized severely restricted the number of available explanatory variables that could be included in the various models.

One limitation encountered during the research was the inability of both surveys to include some measure of price. Basic economic theory states that as product price increases, the quantity of a product or service demanded decreases [Ref. 8]. The theory here is that a person's propensity to use drugs would be determined, in part, by the price of the product.

Attempts were made to use geographic location as a proxy for price. Each military service branch has base locations grouped in certain geographical areas (i.e., Marines/Navy on the coasts, Air Force scattered throughout the Midwest). As such, service members face different monetary prices based on their respective locations. If a respondent's location at the time of their self-admitted drug use was known, price could then be controlled for based on the geographic region.

However, the DODWWS survey only groups the individual responses into three broad world regions: (1) Continental U.S. (CONUS); Outside Continental U.S. (OCONUS); and CONUS Afloat (defined for those aboard ship). In addition, the NHSDA location variables proved equally unusable as a proxy for price due to their highly aggregated nature. The NHSDA

grouped their responses into one of four census regions (Northeast, North Central, South, and West). If price is a significant indicator of drug use, its affect on that use will be inappropriately assigned to the deterrence effect of the military services' drug testing program. That is, the estimates obtained in this thesis will tend to overestimate the true effect of the service policies.

Another possible limitation is that there may be a selection bias with respect to the caliber of prospective recruits that join the military. Although it was previously determined that it was unlikely that the inclusion of Air Force personnel into an all-military population introduced a selection bias, we still cannot rule out the possibility that selection bias is not present. Personnel who decide to join the U.S. military may be pre-disposed not to use illicit drugs for unobserved characteristics or factors unrelated to the service drug testing policies. If these people are, because of these unobserved characteristics, also more likely to serve in the military, then the estimated military-civilian results will overstate the true impact of the military service' drug testing programs. However, the NHSDA and DODWWS data files do not contain detailed socio-economic data on individual respondents, which is necessary to determine if individuals who enlist in the military are different from their civilian counterparts who choose not to serve in the military, and on what characteristics they differ.

Despite these possible limitations, the underlying premise remains that the services' drug testing programs are instrumental in deterring illicit drug use. While this

thesis has provided research to support this view, the true deterrence rates attributed to the service policies may be smaller in magnitude than those estimated here.

C. RECOMMENDATIONS

Two principal recommendations result from the findings and limitations of this thesis. One is that future studies on the deterrence effect of the services' drug testing policies should be conducted which include:

- Controls for price and income in order to assess what portion of drug deterrence can be attributed to these economic forces.
- Detailed socio-economic data regarding both the respondents who choose to enter into the military service as well as those who choose not to enlist.

The second recommendation is that the NHSDA and DODWWS data surveys be improved with respect to information provided, specifically, inclusion of socio-economic information on respondents as well as specific geographic regions.

APPENDIX A. SERVICE SPECIFIC MARGINAL EFFECTS

Table A.1 Marginal Effects of Drug Testing Deterrence[1]
(Navy/Marine Corps, Air Force versus Army)

INDEPENDENT VARIABLES		ENLISTED DRUG USE		OFFICER DRUG USE	
		DRUG30	DRUG12	DRUG30	DRUG12
NVMC		-0.11%*	-0.35%***	0.20%	0.23%
USAF		-0.39%***	-0.78%***	-0.07%	-0.57%
JENL	JOFF	1.34%***	3.17%***	0.88%*	1.88%**
ENL	WOFF	0.61%***	1.40%***	-0.05%	-0.25%
MALE		0.09%	0.27%**	-0.10%	-0.24%
SINGLE		0.44%***	0.64%***	0.57%	1.29%***
BLACK		-0.07%	-0.23%**	0.79%	0.71%
HISPANIC		0.08%	-0.05%	1.49%**	2.11%**
OTHRACE		0.01%	-0.12%	0.91%	0.68%
AGE1		0.33%	1.44%***	N/A	N/A
AGE2		0.39%*	1.17%***	-0.51%*	-0.66%
AGE3		0.10%	0.21%	-0.40%**	-0.67%**
NOHSD	HSGED	-0.25%	0.02%	0.11%	1.36%
GED		0.94%***	1.38%***	N/A	N/A
SOMCOLL		0.05%	0.10%	0.52%	0.55%
COLLGRAD		-0.002%	-0.02%	N/A	N/A
CONUS		0.30%***	0.58%***	-0.07%	0.10%

Source: DODWWS Enlisted and Officer Drug Use Models (EQ.1 and EQ.2).
[1] Percentage point difference in illicit drug use between base case and when selected attribute equals 1. *** Significant at 99 percent level of confidence; ** Significant at 95 percent level of confidence; * Significant at 90 percent level of confidence. N/A - Not Applicable.

Table A.2 Marginal Effects of Drug Testing Deterrence[1]
(Navy and Marine Corps versus Army)

INDEPENDENT VARIABLES		ENLISTED DRUG USE		OFFICER DRUG USE	
		DRUG30	DRUG12	DRUG30	DRUG12
NVMC		-0.11%*	-0.33%***	0.22%	0.22%
JENL	JOFF	1.66%***	3.04%***	0.49%	1.62%**
ENL	WOFF	0.74%***	1.22%***	-0.15%	-0.25%
MALE		0.11%	0.27%**	-0.09%	-0.19%
SINGLE		0.34%***	0.49%***	0.53%	1.09%***
BLACK		-0.07%	-0.25%**	1.10%*	0.93%
HISPANIC		0.09%	-0.04%	2.02%***	2.47%**
OTHRACE		0.04%	-0.11%	0.63%	0.40%
AGE1		0.27%	1.68%***	N/A	N/A
AGE2		0.27%	1.27%***	-0.58%	-0.54%
AGE3		0.09%	0.31%	-0.29%	-0.49%
NOHSD	HSGED	-0.24%	0.02%	0.21%	1.42%
GED		0.87%***	1.29%***	N/A	N/A
SOMCOLL		0.02%	0.10%	0.64%	0.60%
COLLGRAD		0.03%	-0.13%	N/A	N/A
CONUS		0.27%***	0.62%***	-0.07%	0.06%

Source: DODWWS Enlisted and Officer Drug Use Models (EQ.3 and EQ.4).
[1] Percentage point difference in illicit drug use between base case and when selected attribute equals 1. *** Significant at 99 percent level of confidence; ** Significant at 95 percent level of confidence; * Significant at 90 percent level of confidence. N/A - Not Applicable.

APPENDIX B. MILITARY VERSUS CIVILIAN MARGINAL EFFECTS

Table B.1 Marginal Effects of Drug Testing Deterrence[1] (Service versus Civilian and Military versus Civilian)

INDEPENDENT VARIABLES	SERVICE V. CIVILIAN		MILITARY V. CIVILIAN	
	DRUG30	DRUG12	DRUG30	DRUG12
MILITARY	N/A	N/A	-11.17%***	-12.26%***
ARMY	-9.96%***	-13.28%***	N/A	N/A
NVMC	-10.59%***	-15.53%***	N/A	N/A
USAF	-13.52%***	-20.51%***	N/A	N/A
FEMALE	-5.79%***	-7.09%***	-5.77%***	-7.06%***
MARRIED	-8.30%***	-12.35%***	-8.32%***	-12.38%***
BLACK	-2.12%***	-5.21%***	-2.02%***	-4.97%***
HISPANIC	-5.41%***	-8.82%***	-5.33%***	-8.67%***
OTHRACE	-1.76%	-4.65%***	-1.61%	-4.42%**
AGE2	3.25%***	4.81%***	3.17%***	4.64%***
AGE3	-0.17%	-2.27%**	-0.18%	-2.27%**
AGE4	-5.93%***	-11.20%***	-5.82%***	-11.05%***
NOHSD	6.32%***	8.40%***	6.30%***	8.36%***
HSDG	3.55%***	7.12%***	3.74%***	7.35%***
SOMCOLL	2.44%*	4.82%***	2.05%	4.29%***
COLLGRAD	-5.23%***	-3.94%***	-5.21%***	-3.84%**

Source: DODWWS/NHSDA Merged Data Set Drug Use Models (EQ.5 and EQ.6).
[1] Percentage point difference in illicit drug use between base case and when selected attribute equals 1. *** Significant at 99 percent level of confidence; ** Significant at 95 percent level of confidence; * Significant at 90 percent level of confidence. N/A - Not Applicable.

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